ENGINEERING CASE LIBRARY

ECL 264

MY ACHING BACK

In this case, a railroad maintenance worker claimed to have injured his back while positioning guide wheels on railroad tracks, i.e., while using a guide-wheel device which makes it possible for automotive vehicles, e.g., cars and pickup trucks, to travel on railroad tracks. Among the aspects included are: circumstances of the alleged injury; description of the guide wheels; explanation of operation, statements and testimony (depositions) of the injured party, designer, and expert witnesses; exploration of human factors and physical capabilities of potential users; time sequence of events; and some unique aspects of the litigation.

C. O. Smith

This engineering case was prepared in fulfillment of P. O. 85-35128 under the sponsorship of the Division of Training and Manpower Development, National Institute for Occupational Safety and Health.

All names, but no pertinent facts, have been changed.

MY ACHING BACK PART A

Mr. MacGowan is a professional engineer who is occasionally retained by lawyers as an expert witness with regard to design of various mechanical devices. About the 5th of October 1983, Mr. MacGowan received a phone call from a defendent's lawyer.

Good morning, Mr. MacGowan. My name is John Hapgood. I am an attorney representing Snowshoe Railroad. I understand you have worked with attorneys on litigation involving questions of design and function of mechanical devices.

MacGowan: That is correct. I have investigated a variety of situations involving questions of design and/or manufacture. I have testified by deposition and in the courtroom in some of these.

Hapgood: Fine. We are being sued by an employee, Mr. Robert Hope. He claims that he injured his back while operating a "high-rail" device during his normal duties as a signalman. Can you help us?

MacGown: Possibly. First, let me be sure what you mean by a "high-rail" device.

Hapgood: I would expect that you have sometimes seen ordinary pick-up trucks or sedans driving along a set of railroad tracks rather than on a highway where they normally operate. A high-rail device is actually a set of guide wheels with one wheel for each corner of the vehicle. These wheels are flanged, much like normal railroad car wheels, and keep the automotive vehicle on the tracks. These guide wheels carry little of the load from the vehicle and its contents. This load is largely carried by the tires with motive power supplied by the engine and drive train through the tires in the same way as in normal highway use.

MacGowan: OK. I suspect the device thus lowers/raises the guide wheels through some sort of mechanical linkage using a lever or through a hydraulic mechanism.

Hapgood: As I understand it, each of the four guide wheels is raised or lowered by operating a lever, with each wheel being set independently of the other three.

MacGowan: OK. That sounds like something within my area of expertise. Obviously, I can't be sure how much I can help you until I know much more about this case.

Hapgood: I understand. I'll send you some information, specifically: a summary of Mr. Hope's allegations, his deposition, job description for a signalman, a copy of the Fairhill (manufacturer) Service Instructions and Parts List, and a copy of the Snowshoe Operator's Manual for highway-rail vehicles. That should give you a good starting point. Incidentally, I hope you can review this material and be ready to discuss it with me in a few days as we have a trial date in about two weeks. It is also highly likely that Mr. Edwards, the plaintiff's attorney, will want to depose you before the trial.

MacGown: Fortunately, I should be able to work on this as soon as I receive the material. I'll call you as soon as possible after I have reviewed the information. At that point, I can give you some feeling as to how much I can help you.

Mr. MacGowan received the package on October 8, 1983. Mr. MacGowan reviewed the material sent by Mr. Hapgood and then called him on the phone on October 10, 1983.

CAST OF CHARACTERS

Mr. Hope:	plaintiff - injured party
Mr. Edwards:	attorney for Mr. Hope
Mr. Hapgood:	attorney for Snowshoe RailRoad, defendant
Mr. Roper:	attorney for Fairhill, manufacturer of the high-rail equipment

Mr. MacGowan:	technical expert retained by Mr. Hapgood as an expert witness
Mr. Knight:	engineer/designer with Fairhill
Mr. Campus:	technical expert retained by Mr. Edwards as an expert witness

LIST OF EXHIBITS

Exhibit A1

SUBSTANCE OF PLAINTIFF'S ALLEGATION

Mr. Hope alleges he injured his back while using the high-rail device on .February 2, 1981 yet he did not report the injury until February 23, 1981. During that period, he continued about his normal duties. He alleges the track-wheel-assembly (the high-rail equipment) required too much force to operate; (2) was not properly maintained; and (3) may have been in a state of disrepair (based on some adjustments made to the assembly about a year later) with one or more parts slightly damaged. He further alleges a failure to properly instruct employees (specifically him) in the use of high-rail equipment.

It is clear that Mr. Hope did have surgery on his back since the time of the alleged injury. He attributes the necessity for surgery to the injury and subsequent aggravation.

EXHIBIT A2

RAILROAD INDUSTRY JOB ANALYSIS

Signalman

Jobs which are common throughout the railroad industry have major similarities from property to property. While minor variations do exist from railroad to railroad, and sometimes from location to location on the same railroad, the underlying personnel req irements of a specific job classification tend to remain relatively constant throughout the industry. With this fact in mind, the Railroad Personnel Association has developed this job analysis consisting of three basic parts:

PART A - Duties and Responsibilities; this is a list of core tasks which are normally the "backbone" of the job.

PART B - Critical Personnel Requirements; this list defines the underlying behaviors that are required of the incumbent to perform the core tasks.

PART C - Job Setting Characteristics; this part describes the conditions under which most incumbents perform the job.

Job information was supplied by a Task Force (PART D) made up of (1) job incumbents and (2) supervisors or others intimately familiar with the job; they were drawn from several different railroads. Professional direction was provided by C. H. Lawshe, PhD, Licensed Industrial Psychologist, 1005 Vine Street, West Lafayette, Indiana 47906. General procedures used and technical data are included in Part E.

Prior to release for distribution to the railroad industry, the document was reviewed and approved by the Job Analysis Project Steering Committee of the Railroad Personnel Association.

GENERAL OVERVIEW

Job Summary. The duties of signalman encompass the construction, installation, repair, maintenance, testing, and inspection of signal systems. These signal systems include automatic block signal systems, traffic control systems, train stop, train control and cab signal systems, interlocking systems, rail-highway grade crossing protection, automatic classification yards, hot box detectors, broken flange detectors, and other similar devices, appliances; and systems. (from Federal Hours of Service Act)

Dictionary of Occupational Titles. The DOT lists one related job: 822.281-025 Signal Maintainer.

Progression. Essentially all Signalmen begin as Signal Helpers, Assistant Signalmen, Student Signalmen, or in other classifications which are probationary and/or training jobs. Those who are successful progress to the Signalman classification.

Exhibit A2 (continued)

PART A - DUTIES AND RESPONSIBILITIES

The statements in this part are work behaviors or actions performed to achieve the objectives of the job. They were identified by the Task Force and are sometimes called *tasks* or *job activities*. The Importance Degree following each statement was assigned by the Task Force and indicates its relative importance on an industry wide basis. (5 = Most Important)

1. Operates rail or highway vehicle for transportation to wayside locations to install, inspect, test, maintain, or repair grade crossing warning systems, signals, and signal equipment, such as interlocks and hotbox detectors (Importance Degree: 5)

2. Inspects, tests, and maintains batteries to insure proper operation. (Importance Degree: 4)

3. Inspects and tests signal circuitry, using standard electrical and/or electronic testing equipment (Importance Degree: 4)

4. Replaces defective components, wiring, broken lenses, or light bulbs (Importance Degree: 5)

5. Cleans signal equipment including signs and lenses with cloths and solvent (Importance Degree: 3)

6. Lubricates moving parts on mechanical equipment such as: Switch machines, car retarders, and semaphore signals. (Importance Degree: 3)

7. Inspects, tests, and maintains signal equipment such as: grade crossing warning devices, power switches, and switch air unit controllers (Importance Degree: 5)

8. Installs, tests, and maintains retarder systems. (Importance Degree: 3)

9. Compiles reports including: mileage or track inspected, tests performed, repairs made, and equipment requiring replacement (Importance Degree: 3)

10. May utilize a range of chemical materials including herbicides, paints and solvents (Importance Degree: 2)

Exhibit A2 (continued)

PART B – CRITICAL PERSONNEL REQUIREMENTS

Each numbered and underlined item in this part is a generic category of behavior (a) which can be observed and/or reported, (b) which is common to a variety of jobs, and (c) which was judged by the Task Force to be critical for performing this job in a safe and satisfactory manner. It is sometimes called a *performance domain.*

Listed under each general category is one or more specific job elements identified by the Task Force (a) as commonly occurring and (b) as representative of the category. Collectively, those under a particular category constitute an operational definition of that category and delineate a personnel requirement of the job.

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1. Recognizing Colors

   - Distinguishes colors displayed by signals, informational signs, and apparatus, such as: lights, flags, reflectorized devices, colored placards
   - Distinguishes color coded wires while installing equipment and while performing trouble shooting activities

   This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 3, 4, & 12

2. Understanding Printed/Written Information

   - Reads rule books dealing with safety rules and maintenance of way
   - Reads timetables, special instructions, and book of standards or maintenance manuals
   - Reads manufacturer's equipment manuals and catalogs
   - Reads company job training manuals

   This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 2, 3, 4, 6, 7, 8, & 9

3. Understanding Oral Communications

   - Receives oral instructions from supervisor
   - Receives oral explanation of rules and regulations, sometimes one-on-one and sometimes in classroom
   - Receives oral on-the-job training
   - Coordinates work with co-worker(s) through discussion where effectiveness depends upon understanding others

Exhibit A2 (continued)

3. Understanding Oral Communications (continued)

- Receives track, time, and direction information from dispatcher regarding train movements

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 3, 4, 6, & 7

4. Understanding/Applying Electrical and/or Electronic Principles

- NOTE: All signal systems listed in the Job Summary are operated and/or controlled electrically/electronically; both high and low voltage is involved

- Makes adjustments to and determines source or cause of failure in electrical/electronic systems requiring understanding and application of basic principles

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 2, 3, 4, 7, & 8

5. Making Oneself Understood Orally

- Co-ordinates work with co-worker(s) through discussion where effectiveness depends on being understood

- Provides routine oral status or progress reports to supervisor and others, in person, by telephone, and by radio

- Makes track and time requests from dispatcher by telephone or radio

- Advises other railroad personnel, and sometimes the general public, regarding track conditions and provides other information

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 3, 6, 7, & 8

Exhibit A2 (continued)

6. Understanding Graphic Information

- Reads location circuit plans during initial construction, during troubleshooting, maintenance, and testing activities and while replacing components
- Reads pen recorder tapes to secure various kinds of information including signal operation history, hotbox evidence, and time intervals
- Reads track profile giving divisional layout of signal equipment and other information pertinent to signal work
- Reads schematic diagrams in maintenance manuals and instruction manuals describing circuits, mechanical components, and performance characteristics

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 2, 3, 4, 7, & 8

7. Understanding Visual Displays

- Observes and understands signals governing train movment
- Observes and understands hand signals employed during construction, maintenance, and repair activities
- Reads test equipment scales and indicators
- Reads instrument panel indicators while performing maintenance operations on equipment, including: centralized traffic control panels, generator room power and test panels, retarder control panels, and hotbox detector panels

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 2, 3, 4, 7, & 8

8. Judging Condition or Status of Objects/Parts

- Examines parts/objects for wear and defects while performing inspection or repair activities; included are a wide variety of items such as: rods and gears in power switches, retarder shoes, insulated joints, bond wires, relay contacts, and poles

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 2, 3, 4, 5, 6, 7, & 8

Exhibit A2 (continued)

9. Understanding/Applying Mechanical Principles

- Makes adjustments of and determines cause or source of failure in mechanical components of those systems listed in Job Summary requiring understanding and application of basic mechanical principles

- Applies mechanical principles in the lifting and moving of signal equipment

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1, 4, 6, 7, & 8

10. Climbing and Balancing

- Climbs poles to a height of 45 feet with occasional instances of greater height (Maximum height of poles used by some railroads reaches approximately 100 feet)

- Climbs stationary ladders, sometimes to a height of 50 feet, and maintains balance while installing and working on signal equipment

- Maintains balance while installing and working on signal equipment on open track trestles and bridges

- Maintains balance while walking on uneven terrain

- Maintains balance on sloping right of way while installing and maintaining equipment and while cutting brush

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 4, 5, 6, 7 & 10

11. Using Hand Tools

- Performs a wide range of construction, installation, maintenance, and repair activities requiring constant/frequent use of hand tools; included are:

terminal wrench	screwdriver	pliers
pocket-knife	hammer	crescent wrench
hammer	hacksaw	chisel
punch	hand drill	soldering iron/gun
wire strippers	eyelet crimper	

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 2, 3, 4, 6, 7, & 8

Exhibit A2 (continued)

12. Operating Motor Vehicle

- Operates highway vehicle for transportation to wayside location
- Operates on-track vehicles including "high rail" trucks, and motor cars

This performance domain is a component of each of the following "Duties and Responsibilities" listed in PART A: 1

13. Exercising Physical Strength and/or Endurance

CHL's NOTE: The Task Force did not consider this performance domain to be a "critical personnel requirement"; in the initial evaluation procedure, after extensive group discussion, five of the sixteen members rated it as "critical." However, members of the Task Force unanimously agreed that the following statements prepared by an earlier physical demands and environmental conditions task force* accurately describe the job:

- Lifts cross arms (as much as 60 pounds) by rope to top of pole (25 feet or higher) while standing on climbers
- Lifts, with assistance, such items as power switch machines, reels of cable, signal heads, and poles
- Carries storage batteries between job site and vehicle
- Carries numerous other items between vehicle and job site including: relays, rectifiers, transformers, signal motors, case wire, switch circuit controllers, insulated joints, flashing light signals, and electronic equipment
- Classified as heavy work (Defined by the U.S. Department of Labor as "Lifting 100 pounds maximum with frequent lifting or carrying up to 50 pounds")

*These items and those on the following page which are starred were identified by an earlier Task Force. Findings are presented in Consulting Report No. 60 by C.H. Lawshe, Ph.D., dated May 26, 1978, and distributed by the American Railroad Association.

Exhibit A3

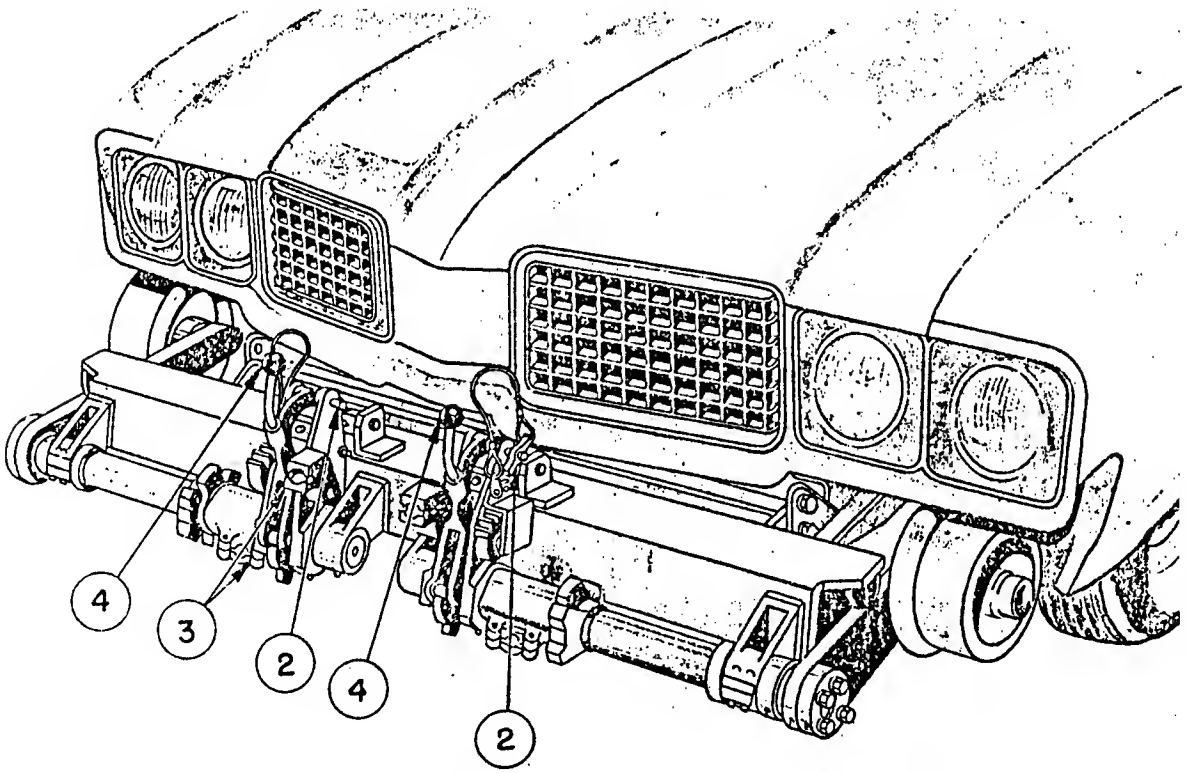
Excerpt from Fairhill Service Instructions for Series 0307, Station Wagons and Sedans, 1/2 and 3/4 Ton Pick-ups.

TO USE ON RAILROAD TRACK: See diagram.

1. Drive vehicle onto track, pneumatic tires centered on rails. This may be easily accomplished by driving past the track about 25 feet at any road crossing and then backing vehicle onto rails. It may be necessary to go back and forth more than once to get all four wheels centered on rails.

2. Remove safety pins (2) (two at front and two at rear). Each safety pin has two spring loaded steel balls which lock the pins in position. In order to remove safety pin it is necessary to depress button in "T" end of pin, this releases the ball locks.

3. When placing vehicle on the track lock the rear rail wheels into position first. Push handle (4) to release mechanical lock. As soon as handle has been moved enough to release lock pin from lock slot, the guide wheels will drop to the rail. To prevent guide wheels from dropping to rails it is advisable to insert lever in lower socket (3) - (painted yellow) before mechanical lock is released. Wheels can then be lowered to the rails preventing their striking the rails with full falling force. Wheels will not be damaged if allowed to drop but an injury may be prevented if their descent is under control.



NOTE: OPERATION OF FRONT AND REAR UNITS IDENTICAL.

Remove hand levers from lower socket (3) and insert in upper socket (3), then lift up on lever to force rail wheels into the locked position.

4. Replace safety pins (2). As mentioned above, the button in "T" end of pin must be depressed to release ball locks in order to insert safety pins.

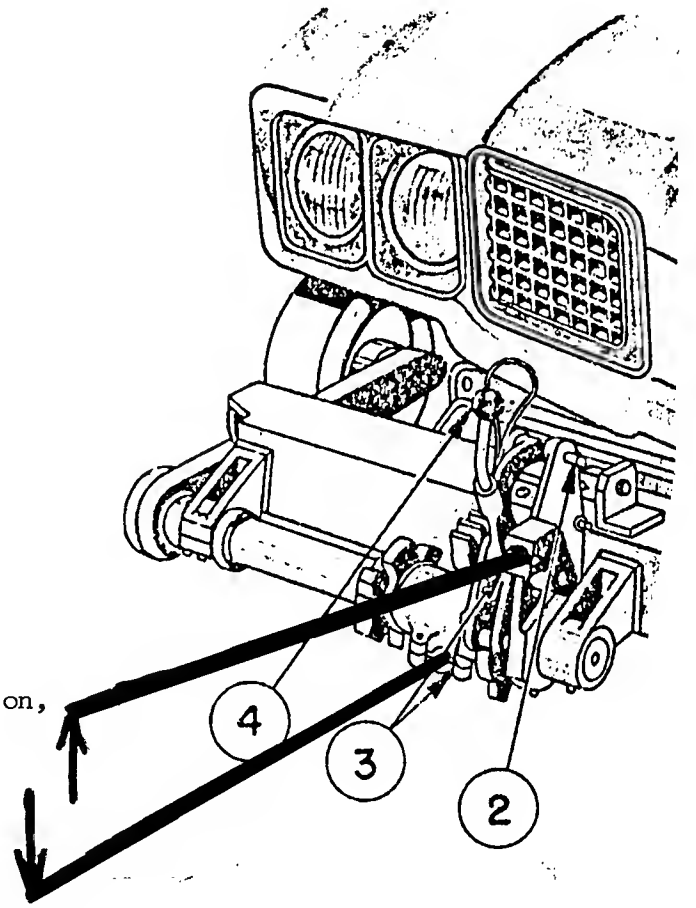
5. After rear rail wheels are locked in position follow the same procedure and lock each of the front rail wheels in the on-track position.

6. CAUTION--Check each rail wheel to see that it is on the rail. It is a good practice to double check to be sure that all four guide wheels are down and flanges are inside the rails, and the four safety pins (2) are in place.

7. After all four guide wheels are locked in the on-rail position, secure the front wheels in the straight ahead position with the steering wheel lock located on the steering column.

This assembly is not designed for high speed on-track operation. It should not be operated at speeds above 45 MPH on tangent main line track, but railroad rules governing speeds should be observed at all times. Speeds should be reduced on curves and branch lines depending on conditions. CAUTION--Reduce speed when running through a switch, especially when movement is toward the point of a self guarded frog.

Exhibit A3
(continued)



With bar in upper location, push up to force wheels into locked, operating position.

With bar in lower location, push down to raise wheels to retracted position

View showing the bar (or lever) in two different locations. The length of the bar is about 3 feet.

Be prepared to stop at all highway crossings. This vehicle does not operate track signal circuits.

The vehicle, with guides, may be operated on the highway at speeds similar to any comparable vehicle under the same conditions.

TO REMOVE FROM RAILROAD TRACK FOR HIGHWAY USE:

1. Approach crossing and stop with front wheels on road crossing. Release steering lock.

2. Remove safety pins (2) on front rail wheels. Insert hand lever into upper socket (3) and lift up on lever to ease releasing of mechanical lock. Remove handlever from upper socket and insert in lower socket (3) - (painted yellow), then push down on lever to raise rail wheels until mechanical lock drops into place securing rail wheels up in the highway position. Follow the same procedure to release and lock rear rail wheels in highway position.

3. Replace front and rear safety pins (2).

RAIL EQUIPMENT

TYPE AND MOUNTING--Manually operated load bearing type bolted directly onto vehicle frame. All weight carried on frame above the springs. (No unsprung weight added).

GUIDE WHEELS--Steel tread wheels have 8-1/2 inch tread diameter, and are heat treated and precision ground. Rubber tread wheels have 10 inch tread diameter. All guide wheels are insulated and mounted on taper roller bearings.

TRACK GAUGE--The gauge of guide wheels is set at 56-7/16" to 56-1/2". Front and rear guide wheels are assembled and adjusted to be centered directly in front and behind the vehicle wheels. When checking gauge of guide wheels, measurement can be taken between the inside or back of flanges. This measurement should read 53-7/16" to 53-1/2".

WHEEL LOAD--350 to 400 pounds for all guide wheels. These figures are based on curb weight of vehicle which does not include passengers or baggage.

OPERATION--Guide wheels are raised and lowered manually, securely held in either position by a mechanical lock which is further secured by a safety pin. When lowering rail wheels into rail position DO NOT hold mechanical locking lever to prevent its falling into locked position.

LUBRICATION--Lubricate moving parts every 2,000 miles or each time basic vehicle is serviced. Repack guide wheels each 10,000 rail miles or when basic vehicle front wheels are repacked and readjusted.

Exhibit A4

Excerpts from the Deposition of Mr. Robert Hope

Questions by Mr. Hapgood, attorney for Snowshoe Railroad

Interjection by Mr. Edwards, attorney for Mr. Hope

1 Q If you could, start about a minute or so before the accident occurred and describe for me what you were doing and how the injury occurred.

A Well, I was on the track. I came up to Spikerville Crossing, stopped on the crossing, got out of the vehicle, took my bar, released both safety pins on the front wheels, inserted the bar in the right front wheel, applied pressure to release the lock, and on the downward motion is when I felt this--I don't know how to phrase it--this crunching or grinding in my back, in my lower back.

2 Q After you felt this grinding or crunching, what did you do?

A Proceeded to take the truck off of the rail.

3 Q And what did that entail?

A The other wheel, but by now the pressure was off of the front, and by the front being down, there wasn't any pressure to speak of on the back, so they came off easy, and I took the truck off the track.

4 Q Where did you go once you had the truck off the track?

A Back toward Marion or Wabash. I may have gone to eat. I don't recall.

5 Q What did you do the rest of the day?

A That I can't answer, either. I don't know.

6 Q You said that you took a bar. Where did you get the bar from?

A Out of the back of the truck.

7 Q What kind of truck was this?

A I think it is an International. No, it is not, either. Chevrolet.

8 Q Do you recall what year it was?

A It's a 1979.

9 Q Do you know about how many miles were on it?

A No, I don't.

10 Q Was this the vehicle that you used every day?

A Yes, it was.

11 Q Had you used that truck since it was brand new?

A Yes.

12 Q Did anyone else have access to the truck to use it?

A Yes.

13 Q Did you park the truck in a particular place each night?

A Yes

14 Q Where did you park the truck?

A At Snowshoe headquarters in Marion.

15 Q Who else had access to the truck?

A Anybody in the Signal Department that needed it. The keys were left there for the truck.

16 Q But you didn't use any other truck other than this one?

A No.

17 Q Is there a particular name that you used to describe these trucks on the railroad?

A I don't know what you mean by that question.

18 Q Like a high-rail truck; is it called a high-rail truck?

Exhibit A4 (continued)

A Yes, that's what we call high-rail vehicles.

19 Q Is it a normal pickup truck, or is it modified to work on the railroad?

A They are modified, or this particular truck was. It was a three-quarter ton.

20 Q How did they modify them for the railroad?

A My particular truck, the rear springs, the rear frame was built up higher. The frame has to be modified to put rear wheels on them.

21 Q Is there any additional equipment that's placed on the truck other than what a normal three-quarter-ton truck would have that you would see on the street?

A A utility bed and rail wheels, of course.

22 Q And where are the rail wheels located?

A Front and rear.

23 Q Is this all one unit that is attached to the frame, these rail wheels?

A Yes, but each wheel works individually.

24 Q But the unit that goes on the front, does it have a wheel on each side to fit on the rails, or is it a separate unit for each wheel?

A It's a rigid bar with a wheel on each--not rigid. Pardon me. It has a bar all the way across it, and it's all one piece. But each wheel works independently on the shaft.

25 Q Where is this assembly attached to the truck?

A To the frame.

26 Q Is there any difference between the assembly for the front and the assembly for the back?

A I really can't answer that.

27 Q When this high-rail truck is up on the rails, do the rubber tires touch the rails.

A Yes.

28 Q And do they barely touch the rails, or does it set on there normally like the ones on the street?

A They do the driving. There is enough pressure there to actually do the driving.

29 Q Was this truck a four-wheel drive?

A No, it was not.

30 Q Do you have any particular safety rules or regulations regarding how you were to remove the high-rail truck from the track?

A You mean as to proper procedure to take it off; is that what you mean?

31 Q Yes, the procedure.

A Well, as far as lifting, yes. There are lifting rules in the book, in the safety book.

32 Q Did you have a copy of the safety rule book?

A Yes.

33 Q Did you have any kind of safety meetings where that rule book was reviewed?

A Yes.

34 Q How often did you have those?

A At least once a year.

35 Q And who conducted those meetings?

A Usually the division engineer.

36 Q Did you ever read your rule book?

A Absolutely.

37 Q How many times would you say you have read it, cover to cover?

A I couldn't begin to answer that.

38 Q Could you briefly tell me what the rule is with regard to lifting?

A Don't lift beyond normal capacity. I don't know the number.

39 Q Were there any other kinds of operator's manuals or manuals of procedure regarding the care and maintenance of the high-rail trucks and how you would remove those

Exhibit A4 (continued)

trucks from the track or put them on the track?

A When the trucks first came out, we were all taught how to put them on and take them off. From that point on, we were expected to remember it.

40 Q Do you mean when the truck was new?

A No, when they first started to come out with high-rail vehicles back in the late 1950's.

41 Q And from that time until your injury occurred, did you use a high-rail truck in the course of your employment?

A If I had a high-rail truck assigned to me, I did.

42 Q When was the first time you had a high-rail truck assigned to you?

A I couldn't answer that.

43 Q More than five years?

A Yes.

44 Q More than ten years?

A That would be hard to say. I really can't say. I would say more than ten years.

45 Q Then over the last ten years you would have used a high-rail truck almost every day while you were working?

A Not on the track.

46 Q How often would you put it on the track?

A Usually only when I had trouble.

47 Q Did you put it on the track to check the signals?

A Periodically.

48 Q What other kinds of trouble would have led you to put the truck on the track?

A Now wait a minute. You said check the signal. What do you mean by that?

49 Q Well, I mean to check the circuits so the signal would operate.

A Oh, pardon me. I thought you meant our regular maintenance. Basically, I would just use it if I was troubleshooting, or if the weather was extreme, so that I could get into a location, I would use it.

50 Q Did the truck have an operator's manual in it?

A Yes.

51 Q Is there anything in that operator's manual about how you were to remove the truck from the track?

A There was no operator's manual for the high-rail vehicles.

52 Q Just a general Chevrolet manual?

A Yes.

53 Q Were there any instructions posted anywhere in the truck specifically designed for high-rail vehicles?

A Yes, as far as tire pressure is concerned.

54 Q Anything else?

A Safety slogans.

55 Q And were those put on by the railroad?

A Yes.

56 Q What kind of safety slogans?

A Well, pertaining to the vehicle itself. Report all accidents immediately to your supervisor.

57 Q You said you took a bar from the back of the truck on the day that you were injured. What did you do next?

A After what?

58 Q After you took the bar from the back of the truck.

A I took the truck off of the track.

59 Q What was the very next step that you took?

A I walked around the front of the truck, took the safety pins out of both front wheels.

Exhibit A4 (continued)

60 Q And where were these safety pins located?

A Each wheel has its own locking handle. There is a safety pin through that locking handle so that it can't be tripped on or off. They have to be removed before you could release the wheels or put the wheels down. It's directly on top.

61 Q After you took the safety pins out, what did you do?

A Inserted the bar.

62 Q Where did you insert the bar?

A On the proper wheel on top. It's an angled bar made for rail wheels.

63 Q What did you do with the bar once you inserted it into the hole?

A The safety pin is removed. Now forward pressure has to be applied to take the pressure off of the locking pin so that you can release it.

64 Q Where is the locking pin located?

A Directly in front. The bar is beside it in front of you, and the pin is right in front of you.

65 Q How long is the bar?

A Three foot, I would say, three and a half, maybe.

66 Q And when you push forward to release the pressure on the locking pin, do you then reach over and do anything with the locking pin?

A Not the locking pin, no.

67 Q Well, what happens when you push forward?

A You push the locking pin forward, the locking lever forward, and now you start releasing pressure on the bar coming back.

68 Q Do you push the bar or pull it towards you?

A You've got to push on the bar to release the pressure on the locking lever. Once you release that pressure, that bar can come all the way down until the pressure is all off of the rear wheels.

69 Q How much force do you need to exert to release that mechanism?

A I can't measure force, but I know how much force it takes to put it on.

70 Q Which is the greater force, to put it on or the force to take it off or remove it?

A I would say it would be equal.

71 Q And what happens to the wheels once you have released all the pressure, the rail wheels, I'm talking about?

A They are slack, sitting on top of the rail. You have to exert the same amount of pressure with each wheel. Usually, after the first wheel is off, the others don't have as much pressure on them.

72 Q You say usually. Are there cases where there is still pressure on them?

A If your wheels are full of ice and snow and stuff, it's bound to be a little bit greater.

73 Q Which wheel did you start with first?

A As you're sitting in the driver's seat, it would be your left front. As you face the vehicle, it's my right front.

74 Q And was that the wheel you were working on when you were injured?

A That is correct.

75 Q Did you hear anything as you were applying the pressure on that front wheel, that downward pressure?

A I don't apply pressure down. It comes down by itself.

76 Q You push forward on the bar?

A That's correct.

77 Q Do you have to use your legs, or can you just push it with your arm?

A You usually have to use the support of your legs, also.

78 Q Is there any particular manner that you were instructed to follow when you are pushing or lifting or pulling?

A I don't understand that question.

Exhibit A4 (continued)

79 Q Well, do you have any kind of safety rule or regulation that tells you how you're supposed to push?

A Yes. If you have to use your weight, you use your knees to use your weight. Don't use your back.

80 Q As you were applying that forward pressure to release that mechanism, did you hear anything?

A No, I did not.

81 Q You just felt something in your back?

A Not when I was pushing forward. When I was coming back. When I was on the downward stroke with it.

82 Q Is there any pressure that you have to apply when it's coming back?

A No. You have the pressure of the truck coming back.

83 Q Does the bar snap back by itself?

A It will. You can't let go of it. It will fly if you let go of it.

84 Q Which pressure is greater, the forward pressure that you have to exert to release the mechanism or the backward pressure?

A The backward pressure coming off.

85 Q Do you have the same sort of backward pressure when you are putting the truck up on the rails?

A No, your pressure is going up then. You are putting pressure on it then.

86 Q And there is no backward pressure at all?

A No, because the wheels don't have any pressure on them at that point.

87 Q After you finished the right front wheel, did you immediately go over to the left front wheel?

A After I had the right one locked up in place, yes.

88 Q Is the truck running, or do you let the engine run while you are moving--

A Yes, I do.

89 Q What gear is the truck in?

A Park.

90 Q Do you have any brakes on?

A The emergency brakes were set, to the best of my knowledge.

91 Q Which wheels do you do first, as a general rule?

A Putting the truck on or taking it off?

92 Q Taking the truck off.

A Taking the truck off, you always take the left front off first as you are sitting in there looking at it.

93 Q You say as you're sitting in the truck looking at it?

A That's correct.

94 Q You start with the left front?

A Or if I'm facing it, it would be your right front.

95 Q And when you're putting on the vehicle, which wheel do you start with first?

A The same. Either front one. It doesn't make any difference. It's either front one first. You always put the front on first.

96 Q When was the first time you reported your injury or notified Snowshoe that you had been injured on the job?

A As near as I can remember, it was February 23rd.

97 Q Did you work every day after you were injured?

A Yes, I did.

98 Q Did you have any problems with your back?

A Not yet, I didn't.

99 Q How long did you work, or how long was it until you started having problems with your back?

A Do you mean did it affect my work; is that what you meant?

Exhibit A4 (continued)

100Q Well, let me rephrase the question. After the accident,when was the first time you felt there was something wrong with your back?

A Well, that night. That very night I knew that something was wrong.

101Q What did you feel that night?

A Soreness is the only way I can explain it.

102Q Was it stiff?

A Just soreness in the lower back.

103Q When did it first start affecting your work?

A It never really did affect my work at all. I completed my job every day.

104Q Now, did you have any restrictions, or did your back make you change the way you were doing anything?

A I was careful when I lifted.

105Q But there was nothing that you couldn't lift?

A Well, I don't know that. I was just careful about what I did lift.

106Q Did you take high-rail trucks on and off tracks?

A I don't think I did.

107Q What did you have to do to set the emergency brakes in those high-rail trucks?

A Your foot; you push down on a lever.

108Q And were those automatic or manual transmissions?

A Automatic.

109Q Did anyone see the accident or the injury occur?

A No.

110Q Did you tell anyone about it that day?

A I don't recall if I did or not.

Mr. Edwards: You mean at the railroad, or his wife?

111Q Well, did you tell your wife, or anything like that?

A Probably, yes. I probably told my wife. Absolutely.

112Q But you didn't tell anybody at the railroad?

A I don't recall.

113Q Did you mention it to anyone at the railroad?

A I may have.

114Q But you don't recall?

A No.

115Q How long were you in the hospital following your surgery on your back?

A I don't know. Five, six or seven days. I really don't know for sure.

116Q What did they do; what type of surgery did they do?

A Microsurgery. They removed the disk. They removed, according to my documents, L4-5.

117Q What treatments, or was there any medicine that you were given when you left the hospital, or any therapy that you were supposed to undergo?

A Let me think. Yes. One in particular was Tylenol 3, which was prescribed.

118Q And what was that prescribed for?

A Pain. And minor exercises.

MY ACHING BACK PART B

On the 10th of October, Mr. MacGowan called Mr. Hapgood.

MacGowan: Mr. Hapgood, I've gone over the materials you sent me. I think I have a good picture of what happened and how the high-rail equipment works. Having had members of my family who have had some back problems, and with one personal experience, I can understand how Mr. Hope could have developed a problem. There is always a difficulty with such an injury since there is no obvious damage or injury as there would be if there were a broken arm. At this point, I have no data on how much force is required to engage or release the wheels. I do note, however, that data related to the job description of a signalman (used in developing the description* in Exhibit A2) indicated occasional lifting of a maximum of 175 pounds and pushing or pulling a maximum of 100 pounds might be required. I would hope that this equipment does not require nearly that effort. If that much were required, I think I would agree with Mr. Hope that that is too much.

Mr. Hope alleges a lack of proper maintenance. The Snowshoe Operator's Manual indicates a number of maintenance requirements as do the Fairhill Service Instructions. In going through the information which you sent, I find nothing which gives me any clue relative to actual maintenance practice on vehicles such as this Chevrolet truck.

In like manner, I simply cannot comment on the question of the state of repair or disrepair at the time of the alleged injury. I simply have no knowledge on that point.

I have questions on the validity of his allegation of failure to properly instruct users. As I read his deposition, there was initial instruction in the use of the high-rail equipment with periodic reminders. As I read the Fairhill Service Instructions (and the Snowshoe Operator's Manual -- which is highly similar with additional figures to make it very graphic), they do not seem at all difficult to understand. I really think that anyone who meets the requirements indicated by the job description could readily understand the high-rail instructions. And Mr. Hope apparently has been using this equipment for at least five years, perhaps more than ten. I do note, however, that the instructions say to stop the engine but Mr. Hope apparently did not. I further note that the instructions say to start with the rear wheels but Mr. Hope was specific that he always started with the front wheels. I can understand a requirement for stopping the engine and setting the brake to avoid a possibility of the vehicle moving forward or backward while the operator is setting or releasing the guide wheels. I'm not sure that I see a need for a distinction in whether the front or rear wheels are fixed first.

I do have some concern that the equipment works "backward." By that I mean that one must push UP on the lever to put the wheels in the DOWN position, and push DOWN on the lever to RAISE or retract the wheels. At the same time, this point of human factors has not been raised, so far as I know.

To summarize, I am not in a position to testify relative to the maintenance or the state of repair at the time of the alleged injury. I am sure that I might later be able to testify on the question of force required for operation, but at this point I have no data. I find a weak case (at best) for his allegation of improper instruction.

Hapgood: I understand. Obviously, you need more information. On the question of maintenance, it is Snowshoe policy that each vehicle operator is responsible for making sure that both routine maintenance and any repairs are performed on any vehicle assigned to him. In this

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*Not included as an exhibit in this case.

case, Mr. Hope was the usual operator of this vehicle and was thus responsible. Although we do not have the information under oath, a number of his fellow employees have indicated that Mr. Hope was unusually "persnickety" about his tools and equipment, even to the point of being fanatic. We do have shop records of regular, periodic, "on-time", servicing of the vehicle. One item on the check list related to servicing of the high-rail equipment.

Since I sent you the previous information, I have depositions of Mr. Ray Knight, a designer/engineer with Fairhill, and Mr. Edward Campus, an independent expert witness retained by the plaintiff's attorney. Mr. Campus has made some measurements of the force required to operate the high-rail equipment and believes too much force is required. I'm sure you will find both depositions interesting and informative. I'll get them in the mail today.

MacGowan: I'm sure they will provide insight. Even so, I would like to see the equipment, or "duplicate" equipment, and perhaps operate it myself before I am called upon to make a deposition. In view of the trial date which you mentioned earlier, that doesn't leave much time.

Hapgood: I'm glad you mentioned that. Trial has been postponed and is now set for the latter part of April.

MacGowan: I'm glad of that. That will give me some time, not only to digest what Knight and Campus have to say, but to do something about rebuttal, if necessary -- as is highly likely.

After review of the two depositions, Mr. MacGowan called Mr. Hapgood again, this time on 18 October 1983.

LIST OF EXHIBITS

Exhibit B1

Excerpts from the Deposition of Mr. Ray Knight, Engineer/Designer with Fairhill, manufacturer of the high-rail equipment.

Exhibit B2

Excerpts from the Deposition of Mr. Edward Campus, an independent expert witness retained by Mr. Edwards, attorney for the plaintiff.

Exhibit B1

Excerpts from the Deposition of Mr. Ray Knight, Engineer/Designer with Fairhill, manufacturer of the high-rail equipment

BY MR. EDWARDS

1 Q Now don't include the part that you have learned, if any, from your attorney. Could you tell me what you have learned with regard to the case of Robert Hope versus Snowshoe, what facts do you know?

MR. ROPER: What do you know about it, other than what I told you, if anything?

A THE WITNESS (Mr. Knight): The only information I have other than that received from my attorney or my company's attorney would have been in a brief discussion with Mr. Hapgood this morning.

BY MR. EDWARDS

2 Q What are those facts:

A The information that Mr. Hapgood gave me this morning was basically a description of the vehicle and the alleged circumstances that caused the injury of the individual, the plaintiff.

3 Q What were you told about how the injury happened?

A I was told that Mr. Hope alleges that he injured his back when he attempted to unlock the mechanism so that the vehicle could be driven off the railway and onto the highway. He also told me the description of the vehicle, describing it as a Chevrolet C 30 vehicle equipped with 0307 equipment.

4 Q And that's it?

A That's it.

5 Q Mr. Knight, would you state what human factors were taken into consideration in the design of this 0307 equipment so far as putting it onto the track or taking it off of the track, so far as those are concerned?

A We attempted to design the equipment in such a way that it would require a minimum of physical effort to apply it to the railroad track or to remove it therefrom.

6 Q Did you run tests to determine how much force or physical effort it requires to remove it or place it on the track?

A This specific model vehicle I assume that we did run some tests on it. We had run previous tests on similar vehicles. I can only assume that in our normal procedure we would have checked this particular size of vehicle. However, I would like to clarify that. That this vehicle apparently was equipped with a special utility body, which probably had not been tested by our engineering department.

7 Q Have you since the date of the injury to Mr. Hope learned the weight of the truck with that utility body on there?

A Yes, I believe I was given some information this morning on that.

8 Q What weight were you told that this truck weighed?

A It is my understanding that the bare vehicle without the high-rail equipment applied to it weighs 3,979 pounds. That's an empty weight.

9 Q Is that also the same as curb weight?

A I would define that as curb weight of the vehicle only.

10 Q Without the special signal or utility body on it?

A I'm not certain. I'm not certain about that, sir. With the high-rail equipment applied to it and the vehicle loaded, it's my understanding that the vehicle weighs about 7,640 pounds.

MR. HAPGOOD: For the record, I just want to clarify as to the source of the information given to Mr. Knight. The 3,979 is a figure that was given

Exhibit B1 (continued)

to me for vehicle E 1358. The figure of 7,640 pounds is from another vehicle of which I do not at present have the vehicle number. It is apparently a similar vehicle. So the figure of 7,640 pounds is not a figure which represents the loaded weight of vehicle E 1358. It is another vehicle.

BY MR. EDWARDS

11 Q Do you know what reason you were given this information this morning for?

A I can only assume, sir, that it was given to me for my general information and understanding.

12 Q Now I asked you earlier if there were any facts that you had with regard to this incident, and you told me just briefly that a man was injured and you didn't give me these facts. Now have you been furnished any other facts other than these facts by Mr. Hapgood.

A I'm not aware, sir, that there are any other facts that I have in my possession given to me by Mr. Hapgood.

13 Q What's the significance of the high-rail equipment and this 7640 pounds being on there, Mr. Knight?

A I think the significance is that our 0307 equipment is rated for application to vehicles that have a gross vehicle weight of 7800 pounds or less.

MR. ROPER: On rail?

THE WITNESS: On rail, that's correct.

BY MR. EDWARDS:

14 Q And you're stating from this information that the 7640 pounds falls within the 7800 pounds. Is that the significance?

A I believe so, sir.

15 Q It's close to the limit, though, isn't it?

MR. ROPER: I'll object to the question as vague and ambiguous. I don't know that you mean by close. What you mean by close and what he means by close may be two different things.

MR. HAPGOOD: I'll join in that objection.

BY MR. EDWARDS

16 Q Is it close, sir?

MR. ROPER: If you think it's close, then you can say it's close.

THE WITNESS: It's within the acceptable limits, sir.

BY MR. EDWARDS

17 Q What if this weighed 7810 pounds? Would this be outside of the acceptable limits?

A Yes, sir, it would.

18 Q And would it be dangerous to drive a truck such as that?

MR. ROPER: On the road or on the rail?

MR. EDWARDS: On the rail.

A THE WITNESS: We feel that safety might be compromised if you exceed the 7800 pound limit.

BY MR. EDWARDS

19 Q And might the limit of 7810 pounds also make it so that the machine is more difficult to take off and on the track?

A The difference of ten pounds would be almost negligible.

20 Q How about the difference between 7640 pounds and 7810 pounds. That wouldn't be so negligible, would it?

MR. ROPER: Counsel, you're asking a question that is vague and ambiguous in that you are not specifying where the weight is focused, over what wheel it's focused, if it's evenly distibuted or what and it all makes a significant difference.

BY MR. EDWARDS

21 Q It does make a significance where the weight is focused, doesn't it?

A Yes, it does.

Exhibit B1 (continued)

22 Q Would you explain to me the variables involved in determining what force a man has to lift to --

MR. ROPER: To activate the mechanism?

MR. EDWARDS: Yes, to take it on and put it on the track.

MR. ROPER: Object to the form of the question. It mischaracterizes. I don't know if there's any lifting involved, pushing and some force exerted. But to that extent certainly the witness may answer the questions, if he's able to. What variables are involved to activate the mechanism?

A THE WITNESS: The variables involved are these: the gross vehicle weight is important. It is important that the equipment be applied to the vehicle to certain recommended dimensions from the rail to the center of the torque tube. It is important that the vehicle, that the equipment be properly lubricated. It is important that the vehicle tire pressure be maintained at recommended levels. It is important that the pilot wheels that guide the vehicle on rail be initially adjusted to carry 350 to 400 pounds per pilot wheel at curb weight of the vehicle. It is important that the pilot wheel loading does not exceed 700 pounds under any condition of cargo loading.

MR. ROPER: Per wheel?

THE WITNESS: Per wheel. Those are the important considerations and variables that are involved.

BY MR. EDWARDS

23 Q In activating the mechanism and the amount of force required to do so?

A That's correct.

24 Q Have there been any studies or tests made as to the importance of force required to activate the vehicle, take it on and off the track under perfect conditions as it leaves the factory?

A Yes, there have.

25 Q Would you tell me what those are?

A I was involved in the original design of the 0307 equipment, and under curb weight conditions one of the design parameters that I was working on was to be able to lock this mechanism in place or to unlock it at curb weight conditions with a force not exceeding 100 pounds applied normal force perpendicular to the locking lever.

26 Q Is this 100 foot pounds that you're speaking of?

A No, sir. It is 100 pounds of force.

27 Q 100 pounds of force necessary for the man to apply against the --

A Lever.

28 Q The lever?

A Yes.

29 Q Okay. Where did the 100 pounds come from?

A That, sir, was an arbitrary value that I selected as a designer.

30 Q Did you test this in any way to see how closely you came to the 100 pounds?

A Yes, I did.

31 Q How did you do that?

A I applied a strain gauge.

32 Q A strain gauge?

A Strain gauge. An electronic strain gauge applied to the locking lever and measured the stress or strain in the lever, and from that calculated the normal force that would produce such a strain.

33 Q In other words, you used the lever itself and then calculated how much force it would take so far out from the lever itself, or the locking mechanism itself?

A That's correct.

34 Q You never did actually measure how much poundage was required to push the lever itself?

A I believe I did, sir. I believe this is a valid method of making such a measurement.

Exhibit B1 (continued)

35 Q But you didn't directly put a spring on it or a weight or anything like that and determine how or what force was required on the lever itself?

A No, sir, I did not.

36 Q What were the conditions of your test? Under what gross vehicle weight did you use?

A The vehicle was at curb weight. I don't recall what specific vehicle the test was made on, so I cannot precisely define the gross vehicle weight.

37 Q I don't believe I understand that when you say you did it at curb weight. What do you mean by that?

A At curb weight meaning that the high-rail equipment was attached to the vehicle. The vehicle was on the rail, and we measured the forces required to lock the mechanism in position so that the vehicle could be driven on the rail. There was no cargo, no passengers in the vehicle under that condition.

38 Q What was the curb weight of this vehicle when you did that?

A I don't know, sir.

39 Q Did you not know that because that's not important or because you measured it to be 350 to 400 pounds per curb weight on the pilot wheels?

A I don't know specifically because we have run tests using quite a variety of vehicles.

40 Q You stated then that the pilot wheel loading did not exceed 700 pounds per wheel?

A No, sir, I did not state that. I only stated that those measurements were taken when the pilot wheel loads at curb weight was within the range of 350 to 400 pounds each.

41 Q I'm going to assume that the pilot wheel loading does not exceed 700 pounds per wheel -- well, is that something else?

A That is correct.

42 Q What is that?

A Under any cargo load condition the loads of any of the four pilot wheels should never exceed 700 pounds.

43 Q Now what was the result of this test that you ran so far as the amount of force that was required to be exerted?

A I personally made the judgment that that was a satisfactory effort to lock the wheels into position or to unlock them for travel on the highway.

44 Q And it required 100 pounds of force?

MR. ROPER: Less than 100 pounds.

THE WITNESS: Less than 100 pounds.

BY MR. EDWARDS

45 Q How much less?

A I don't know, sir. I don't have any document record in my possession that records those values.

46 Q You just have a recollection that it was less than 100 pounds?

A I recall that I met the criteria that I was working under at that time to develop equipment that could be activated at force less than a hundred pounds.

47 Q You just arbitrarily pulled this 100 pounds out of the air, so to speak?

A In a sense. Obviously I am a small person, physically, about 5 ft. 4 in. tall, weighing about 130 lbs. I felt that if I could exert 100 lbs force, any railroad worker could.

48 Q Now with regard to the circumstances which would be different than the circumstances when your test was made, would lack of lubrication change the amount of force required?

A Yes, in my opinion lack of lubrication could change the amount of force required.

49 Q How about weather? At zero or from zero to ten above Fahrenheit, would that change and make it require more force?

MR. ROPER: As compared with 60 degrees or 70 degrees?

Exhibit B1 (continued)

BY MR. EDWARDS

50 Q As compared to what it was when you ran your test. What was it when you ran your test?

A I believe that when our tests were made they were done at room temperature, which would be approximately 70 degrees Fahrenheit.

51 Q Was your test done inside?

A I believe it was, sir.

52 Q Inside a heated building?

A Yes.

53 Q Presumably in your engineering department you have the ability to run these tests?

A Yes.

54 Q Now my question is if it were zero or colder, would it make any difference so far as the amount of force that would have to be applied?

A Sir, I would believe that at cold temperatures the viscoaity of the lubrication would be somewhat higher and it might increase the force required to lock the mechanism.

55 Q What if the cold weather reduced the tire pressure? Would that also increase the amount of force that was required?

A Yes, 1 believe it would, sir.

MR. HAPGOOD: Are you talking about the lock or unlock?

BY MR. EDWARDS

56 Q ls there a difference regarding lock or unlock so far as any of these things we've been discussing?

A There's significantly no difference in the major effort. Only in the time of force application would differ.

57 Q The time that the force is applied?

A That is correct.

58 Q Can you explain that to me what you mean by that?

A When the mechanism is being locked into position for rail travel, the force muat be applied over a greater number of angular degrees of motion than is required to unlock the mechanism. It only takes a very few degreea of motion to unlock the mechanism as compared to locking the mechanism.

59 Q And the force ia applied over a leaser degree of arc?

A That's correct, air.

60 Q How about if there was a difference between amount of springs or the type of springs on the vehicle which you had, the station wagon, and the truck which Mr. Hope was using? Would that cause a difference in either the amount of force or the amount of length of that force would be applied?

A The spring rate of the vehicle could affect the magnitude of the forces required to apply the rail equipment. Excuse me, correction, to lock the rail equipment.

61 Q You call it, quote, "lock the rail equipment," when you're talking about actually activating, putting it on the track and taking it off the track, is that right?

A To put it on the track it's a locking motion. To remove it from the track it's an unlocking motion.

62 Q When you use the word locking, that seems by its very nature to signify some diminutive type turn of a key or something like that, but that's not what you mean to imply. This is not just a slight bit of effort involved in this, is it? It requires a hundred pounds.

MR. HAPGOOD: I'll object to that question, because it's not an accurate statement of what the testimony has been up to this point.

MR. ROPER: He's described it as minimal physical effort. I don't know if that fits locking or unlocking a key.

MR. EDWARDS: l'm using the word locking, the word that you are using.

MR. ROPER: 1 object to arguing with the witness.

Exhibit B1 (continued)

BY MR. EDWARDS

63 Q Why do you use the word locking? I don't like the word locking.

A I think it's descriptive of what the hardware does, sir.

64 Q It's descriptive of locking the wheel in place so that it doesn't move, is that correct, from an engineering standpoint?

A It's descriptive in the sense that we maintain desired pilot wheel or guide wheel loads.

65 Q Now if this pilot wheel were -- if the amount of pressure on this pilot wheel were 500 pounds, as opposed to 350 to 400 pounds, would that make a significant difference as to the amount of force that had to be required to activate this?

A Yes, sir, it would.

66 Q How about if the shock absorbers were different on this truck which Mr. Hope had and the station wagon which you tested? Would that make a difference in the amount of force that was required to lock or unlock this vehicle?

A No, sir, I believe it would not. The shock absorbers as such would not have any significant difference.

67 Q That would be taken care of in the springs?

A Would you restate that question, please?

68 Q If there was a difference in the springs on the truck and the car -- and the station wagon, you mentioned that the springs, if they were different, would make a difference?

A Yes, I did.

69 Q Would this make a difference if after this accident or injury it was necessary to, quote, "loosen the frame on the right front to raise the height and adjust the weight?" In other words, to raise the height and assuming also that the man was injured while raising the -- while unlocking the right --

MR. ROPER: Front.

MR. EDWARDS: Front, right.

MR. ROPER: When is this?

MR. EDWARDS: It's done afterwards.

MR. ROPER: Fifteen minutes afterwards or a day afterwards or when?

MR. EDWARDS: Assuming it's necessary to have this done.

MR. ROPER: At any point in time?

MR. EDWARDS: Yes.

MR. ROPER: Two or three years later.

MR. EDWARDS: It was done in December of 1968 and it happened in February.

MR. ROPER: Eight or nine months later. Is the question would that have an effect?

MR. EDWARDS: Would that have an effect, yes, sir.

MR. ROPER: On the force necessary to raise or lower the mechanism?

MR. EDWARDS: Right.

MR. ROPER: Or does that tell you anything about the force necessary, I guess maybe would be more accurate.

MR. EDWARDS: Yes.

MR. ROPER: You can answer the question, if you're able to.

A THE WITNESS: As I understand the question, sir, I think that you're asking whether or not changing the attachment to the vehicle frame might in any way reduce the effort to lock the wheel into place.

BY MR. EDWARDS

70 Q Or unlock, right.

A Or unlock it.

71 Q Right.

A Yes, I believe it might.

72 Q Now if this were on the left front where the man was locking it or unlocking it at the time, if this was

Exhibit B1 (continued)

on the left front and the man was unlocking it at the time, and it was necessary to put a new arm on the left front because the old arm was twisted, would this have required more effort than an untwisted or straight left arm?

MR. ROPER: You're asking him to assume that the arm was twisted when this force was being exerted by Mr. Hope?

MR. EDWARDS: Right, correct.

MR. ROPER: All right.

A THE WITNESS: I can't tell for certain, sir, whether it would have increased or decreased the effort unless I knew in which direction the arm was twisted.

73 Q Does Fairhill recommend or specify that the operator of the equipment stand in any certain position when raising or lowering the vehicle on the track?

A No, sir, I do not believe that they do.

74 Q Did you yourself ever put one of these things on the track and take it off?

A Yes, sir, I have.

75 Q Did you have the amount of effort required that you would say was approaching the 100 pounds?

A Yes.

76 Q Did you really regard that as a minimal effort?

A Would you restate that question? I do not understand the question.

77 Q Well, you said that was a minimal -- originally you said it was a minimal effort.

MR. ROPER: Minimal physical.

MR. EDWARDS: Minimal physical effort, and I did it and it sure didn't seem minimal to me. It seemed like a whale of a lot of effort required.

MR. ROPER: Are you testifying that the vehicle was --

MR. EDWARDS: I'm asking him.

MR. ROPER: -- in the same condition, was unloaded, was properly lubricated, proper adjustment of the wheels, was no more than 375 pounds, or are you testifying to more significant effort? I don't know if you are comparing apples and oranges or apples and apples.

MR. EDWARDS: If you keep testifying, I'm not going to be able to compare anything.

MR. ROPER: Then ask a proper question.

MR. EDWARDS: Read back my question. (Whereupon the requested material was read back by the reporter).

MR. ROPER: Further objection that the question is argumentative on its face.

BY MR. EDWARDS

78 Q Did you feel that the amount of effort required for you to activate the mechanism was a minimal amount of effort?

A Sir, I have difficulty responding to that. I feel that I can activate the equipment. I can either lock or unlock it with a reasonable -- with exerting a reasonable amount of effort, providing that the pilot wheel loads fall within our recommended parameters, and by that I mean no pilot wheel is carrying a load more than 700 pounds under any load condition.

79 Q If one load exceeds 700 pounds --

A Excuse me, may I?

80 Q I'm sorry, I didn't mean to interrupt you.

A May I add one more stipulation to that?

81 Q Go ahead.

A And provided that the measured dimension from the top of the rail to the center line of the torque tube is within recommended values as described in our service manual.

Exhibit B1 (continued)

82 Q Do you feel that there should have been scheduled maintenance for this truck every 6,000 miles by the owners of it, Snowshoe Railroad?

A I feel that Snowshoe should have maintained the vehicles in compliance with our recommendation in our service manual 942.

83 Q Has Snowshoe ever requested your assistance with regard to maintenance schedules or with regard to how to set up schedules to maintain this equipment?

A No, sir, not my assistance.

84 Q Or anybody within your company that you know of?

A I'm not aware that they have asked for that assistance.

85 Q Do you believe that an operator should be specifically trained on how to operate this high-rail equipment on the truck?

MR. ROPER: That question is vague and ambiguous.

BY MR. EDWARDS

86 Q Can you answer?

A Sir, I believe that the operators should be instructed to either do or see that the maintenance is done in compliance with our recommendations and our service instructions and parts list.

87 Q How would you get this information to the operator of the equipment?

A I believe, sir, that that's the responsibility of the operator's supervisor.

BY MR. HAPGOOD

88 Q In response to questions by Mr. Edwards, you mentioned that there were certain human factors which were considered in the design of this 0307 high-rail equipment. Was one of the factors that you considered whether this was to be a one or two person job? And when I refer to a one or two person job, I mean the locking and/or unlocking of the high-rail equipment.

A It certainly was a design objective that the equipment could successfully be locked or unlocked by one single individual.

89 Q In your opinion was that design objective achieved?

A Yes, it was.

90 Q With regard to the criteria that you referred to as being able to lock or unlock the mechanism with the force of less than 100 pounds, was that a criteria that was established by you personally?

A Yes, it was.

91 Q Did you personally perform the tests to determine whether that criteria was met?

A Yes.

92 Q In the final design of the 0307 equipment?

A Yes, I did personally perform that test on a specific vehicle.

93 Q I don't think I have any more questions at this time.

Exhibit B2

Excerpts from the Deposition of Mr. Edward Campus, an independent expert witness retained by Mr. Edwards, attorney for the plaintiff, Mr. Hope

QUESTIONS BY MR. HAPGOOD

1 Q Have you ever been involved in any other cases involving a railroad and high-rail equipment?

A No.

2 Q Prior to your retention in this case, had you ever looked at, tested, or become familiar with any kind of high-rail equipment?

A I had seen them. I had never looked at them in any detail.

3 Q Could you tell me what your fee structure is?

A $100 an hour for any work before trial and a flat fee of $750 for a court appearance.

4 Q Plus, I assume, your travel expenses?

A Yes.

5 Q Can you tell me what facts you were supplied concerning this case?

A Well, I was given some material I have here; drawings and literature supplied by the manufacturer of the device; depositions.

6 Q Well, what were you told about how the accident occurred?

A That Mr. Hope was setting his vehicle on the tracks and hurt his back in some way in the process of lowering or raising the wheels, the track wheels.

7 Q Were you told when this accident occurred?

A Yes. I wrote it down, but I don't recall it.

8 Q Do you have a file with you today of material?

A Yes.

9 Q Maybe we can just run through that real quick. It would save us a lot of time.
(Witness producing documents)

10 Q This is a Fairhill manual for 0307 series rail gear; is that correct?

A Yes.

11 Q I also have what looks like specification sheets and drawings, photographs, engineering orders, change orders; a rather large stack of documents which, I assume, Mr. Edwards supplied to you and he received these documents from Fairhill; is that your understanding?

A Yes. That's my understanding.

12 Q This is the advertising brochure of Fairhill high-rail equipment. Again, this looks like some change orders and general information from Fairhill.
Parts list from Fairhill.
Series 0307, another manual.
Operator's manual for Snowshoe high-rail vehicles.
A series of photographs.

A These I made myself (indicating).

13 Q These are photographs you took?

A These (indicating). Those not.

14 Q These Xerox copies of photographs, I assume they were supplied to you by Mr. Edwards.

A Yes.

15 Q A series of photographs showing the high-rail equipment and the high-rail vehicle being put on the tracks. I assume those were taken when you inspected the high-rail vehicle?

A Yes.

16 Q Do you recall when that was?

A That may have been in June of '82.

Exhibit B2 (continued)

17 Q I also see that you have some depositions. Did you review these depositions?

A Yes.

18 Q Were you told anything about the weight of the truck?

A Well, I am sure I was, but I don't remember.

19 Q Were you told where the accident occurred?

A Where?

20 Q Yes.

A Yes, but again I didn't make a point of remembering it.

21 Q Were you told anything about the weather conditions?

A Yes, yes.

22 Q At the time of the accident?

A Yes.

23 Q What were you told?

A It was wet and cold and icy and snowy.

24 Q Were you told the precise temperature or the temperature range?

A No. That it was very cold. Below freezing I believe.

25 Q Were you told anything about the instruction that may or may not have been given to Mr. Hope concerning the operation of the high-rail equipment?

A Yes. That he hadn't received any specific instructions.

26 Q Were you told of any problems with the operation of the high-rail equipment or the way it operated, either prior to, on the day of, or after the accident?

A No, not that I recall.

27 Q Now, you did come out and make some observations and conduct some tests on the high-rail vehicle involved in the accident?

A Yes.

28 Q And you believe this was in June of '82?

A I think so.

29 Q Can you tell me what you observed about the high-rail equipment when you looked at it in 1982?

A Well, I saw that it was a piece of equipment that had been repaired, for one thing.

I saw that it took a little time and effort on the part of the driver that was there to set the vehicle properly on the tracks; it took him more than five attempts, as I recall.

Then, I believe he illustrated the procedure in lowering and raising the wheels and he indicated, or someone else indicated that there was a procedure to be taken before that which was not done but which was illustrated, the means of measuring the weight on each wheel with a small device that was supplied but was not in proper condition to use.

What I observed then, in watching Mr. Edwards take part in the process of raising and lowering these wheels, was the difficulty attendant on that process; the fact that it's not a straightforward process; that it takes unusual effort and it's hard to predict at what part of the process the effort is required, which throws one off-balance in both a physical and a psychological sense in the expectation of where to provide your strength and where to set your center of gravity. And I made some measurements which were measurements of the amount of force required to lift the bar in the first case and to press the bar down in the second case.

30 Q When you say "lift the bar," do you mean to raise the vehicle into the high-rail position so it can operate?

A I believe the bar is raised in order to lower the wheels or to lower the wheels to the point where the vehicle is set on the train wheels. I am not quite sure of that, but the greater effort is required in pushing the bar up, and that came to 90 pounds on a scale.

31 Q That was a spring scale?

Exhibit B2 (continued)

A A spring scale. I also measured the distance through which each of those efforts had to be moved in order to arrive at a value of foot-pounds, which is the measure of work.

32 Q If I could just back up for a minute to this 90 pounds of force -- is that the proper term, 90 pounds of force?

A Yes.

33 Q -- that you measured. The vehicle was in the -- do you understand, when I say high-rail position, what I mean?

A It's on the rail wheels at that point.

34 Q And it would be able then to be driven down the track?

A That's right.

35 Q And then this 90 pounds force was measured when the bar was pushed up to lower or to remove the tension from the rail wheels; is that correct?

A I am no longer clear on that; whether that's the point at which the rail wheels are being lowered and thereby you are lifting essentially the weight of the truck through a short distance off its rubber tires.

36 Q Well, in any event, was the 90 pounds the maximum force you measured?

A Yes.

37 Q I assume that through the motion that's required to release the rail wheels, the lifting that's required to remove the tension so the rail wheels can be lowered, varies over the course of the distance that the lever arm is moved.

A Yes. That could not be measured with any degree of exactitude, so it's the maximum figure that I --

38 Q During the motion of that lever arm, the maximum force that you measured was 90 pounds.

A That's right.

39 Q Can you tell me what this distance through which -- you said you measured the distance through which the lever arm had to move. Can you tell me what that distance was?

A I believe it was 9-1/2 inches.

40 Q What were the foot-pounds?

A That came to 76 foot-pounds in the upper direction and 70 foot-pounds in the downward direction, so the amount of work required was similar in each operation.

41 Q So, does that mean, then, that the operator of this vehicle was required to exert 76 foot-pounds of force to raise and lower the rail wheels?

A Essentially, yes. However, there is a difference there in the manner in which this work is done. It takes less energy to expend the same amount of foot-pounds when you are pressing something down than when you are trying to raise something. And then to complicate it in this --

42 Q Wait. Can you say that again? I think I have up and down confused here.

A I am talking about the actual act of pushing something up or pressing it down, not whether we are lowering or raising the vehicle. That's why I am trying to stay away from that. The work is done by the person by pushing this bar up. Whatever is happening at the other end doesn't enter this consideration. So, when you are pressing something down, you are using your own weight in order to take over some of that effort, work effort, but when you are pushing something up, you are basing the effort on your muscles. To complicate that, the position in which you are standing, the number of hands you can use while moving something upward and the angle at which you are moving it all relate to how easy or difficult or dangerous or comfortable that work effort is going to be.

In this case, the effort of raising the end of the bar proved to be very difficult and, I think, hazardous, because the end of the bar is being raised in a more or less circular movement. At one point it has to be done with one hand while the other

Exhibit B2 (continued)

hand is used to apply or remove some pins, and then when it's up close to shoulder height, you have, again, the possibility of using two hands and the body has to be shifted a number of times, so that the same muscles are not always in play and, in fact, the body is off-center, off-balance during part of this movement of 90 pounds.

43 Q Did the load or the weight of the truck or the load distribution of the truck enter into your calculations at all?

A No. If I were making some more-detailed calculations, I would try to get that. Of course, when you are working on the front end, the weight on that end is of importance, and whether the weight is distributed between two wheels in front is of importance, but we could never get the accuracy which would permit use of that kind of information.

44 Q Do you intend to make any further calculations at the present time?

A No.

45 Q Have you been requested by Mr. Hope's attorney to make any further calculations?

A No.

46 Q Did you review the Snowshoe operator's manual?

A Yes.

47 Q Did you find any differences between the procedures recommended in the Snowshoe operator's manual and that recommended in the Fairhill material that you reviewed?

A Not that I recall.

48 Q Did you, yourself, go through the procedure of raising and lowering the wheels?

A Yes.

49 Q And did Mr. Edwards also go through that procedure?

A Yes.

50 Q You also mentioned that the equipment has been repaired?

A Yes. It was clear that parts were out of alignment and had been re-attached, braced.

51 Q Were you ever told how many times or how many years Mr. Hope had operated a vehicle equipped with high-rail equipment?

A No. I know he had done it before.

52 Q Were you told the age of Mr. Hope.

A No. I guess he is around 60 or so.

53 Q Now, did you make any models?

A No.

54 Q Did you review any standards, Federal safety standards or State safety standards.

A No. There are no Federal or State safety standards, as far as I know, that relate to this, but there are human factors standards and guidelines for lifting and carrying and the amount of effort and the work that is reasonable.

55 Q Can you tell me what the guidelines, human factors guidelines apply to this case?

A Well, the recommended maximum for lifting and pushing is 60 pounds, and --

56 Q And where do you get that figure from?

A A couple of human factors manuals.

57 Q Specifically which manuals?

A There's one dated 1965 published by an organization TAD, and that's as much as I can remember.

There is a book published by, I believe, Wiley, it's a publishing company, called "Human Factors Engineering." It has similar figures in it. That may go back ten years or more.

There are OSHA standards which don't necessarily apply to this in particular but to proper ways of lifting and carrying and pushing; manual labor, in other words, relating to keeping the body balanced and symmetrical when doing work as much as possible.

Exhibit B2 (continued)

58 Q Do you have any idea what the numbers of those standards are?

A No.

59 Q How do those things apply to this case? Or I believe you said they don't specifically apply to this case?

A They don't apply to a device such as this. However, they apply to the fact that in this case work is being done in terms of lifting, pressing, pushing, raising weights above the shoulders, above the head, actually, depending on how you are holding your body, and the requirements imposed by this device on the positioning of the body in relation to the force to be moved is something that doesn't relate to proper positioning of the body and moving weights and raising loads.

60 Q Are you saying that it's not possible to do this and keep your body balanced?

A That's right. That's my conclusion, yes.

61 Q You say there is a relationship between experience with this type of equipment and danger; is that what you are saying?

A There is a relationship between familiarity with a device and doing it in a manner which you haven't been taught.
As I understand, this man was not taught how to do it properly, so he learned to do it on his own and he developed his own way of doing it, which may have very little to do with the safe way to do it.
The safe way is spelled out in the literature, but the safe way is so impractical that it would not have been applied anyway under those circumstances.

62 Q And what is the safe way to do this?

A The safe way is described in the literature. It says that all of the tires should be checked for pressure; the weight distribution of the vehicle should be checked; the distance between the rail wheels and the track should be checked with a piece of paper; and then you are supposed to get under the end of the bar and raise this thing with a reasonably constant pressure, putting all of the strength of your body under it.

63 Q Now, what were you told about this accident and how it would be unsafe?

A The accident?

64 Q How was it that Mr. Hope was doing it that was unsafe.

A I don't know how he was doing it. I can only assume that someone who had not been trained on the basis of this literature, but who was doing it somewhat in the way that we tried to do it ourselves, could eventually get into trouble by lifting improperly.

65 Q And you think that would be true even in the case of someone who had operated it for many years?

A Oh, yes. If it's done incorrectly for many years, it's just a potential that always exists for an accident happening.

66 Q Is there any better way to design this rail equipment to prevent this?

A Well, I am sure there is. I am not a mechanical engineer, but I can look at a jack that I have in my car and I can see that with that jack and with downward pressure, on a step-by-step basis I can lift a great deal of weight with very little effort.
I don't see any reason why that principle can't be used here or couldn't have been used, and I am sure there are other mechanical principles besides --

67 Q Again I want to make sure I understand all the human factors guidelines that you say relate to this case.
You told us about the recommended maximum for lifting and pushing, 60 pounds; also that there were OSHA standards, not specifically applicable to this case, regarding the proper ways of lifting and keeping your body balanced and symmetrical.
Are there any other human factors guidelines that you have considered that may relate to this case?

A No, I don't think so.

Exhibit B2 (continued)

68 Q Have you formed any opinions or do you have any opinions concerning this case?

A Yes.

69 Q Could you just tell me what those opinions are?

A That the difficulties in properly operating this device, in my opinion, have a great deal to do with the causation of that particular incident, and the conditions under which the work had to be done.

70 Q And what specific difficulties are you referring to?

A The amount of work to be done in terms of foot-pounds; the amount of force to be applied; the position of the body, which required more or less continuous change, and changing from a one-hand operation to two; the difficulty of crouching down under bad weather conditions and perhaps under changing physical conditions of any particular person, which would create an unbalanced or asymmetric position of the body.
The environmental conditions, the cold, the snow, the icy ground or slippery ground; the humidity which may have gotten into the mechanism and thereby made the work effort worse or more difficult than normal; or the lack of lubrication or even the existence of lubrication that had been frozen or reduced to -- reduced in viscosity.
All of these possibilities would have made this particular job at this particular time hazardous and, as I say, had a great deal to do with the occurrence of this accident.

MY ACHING BACK PART C

On the 18th of October, Mr. MacGowan again called Mr. Hapgood.

MacGowan: "Mr. Hapgood, I've reviewed the depositions of Knight and Campus. It is clear that Knight designed the high-rail equipment. I understand how he arrived at the limit of 100 pounds to be exerted on the lever. I understand his rationale although it hardly seems to be good ergonomics!

Mr. Campus' deposition seems clear in terms of what he says. I note that he claims to have measured a force of 90 pounds (obviously less than Knight's maximum) but he states that is too much, that 60 pounds is a limit. He does not indicate the source of that number. He does make reference to a "TAD" publication but that is an unknown source to me.

I gone through the reference material* (such as McCormick and Hammer) which I have on hand and find no anthropometric data which I believe to be pertinent to this situation. I can find data on how much force male and female subjects can exert in some situations (based on specific studies) but none which fit the configuration of the high-rail equipment. Perhaps Mr. Campus will be willing to indicate the documentary source of his data. If he is not willing, I assume it can be obtained by court order.

It appears to me that the key issue at this point is the question of how much force a worker can be expected to exert to operate the high-rail equipment. I will try to find some source of information. At the same time, if you obtain data or any information on possible sources, I would appreciate it very much if you will send me the information."

Hapgood: "I'll see what I can find from Mr. Campus through Mr. Edwards. At the moment, I don't know when your deposition will be wanted, but I'm sure there will be one. I will arrange for you to see and operate the high-rail equipment sometime before you are deposed."

---

*References are listed in Exhibit C1

In mid-November, Mr. MacGowan heard from Mr. Hapgood that Mr. Campus had identified the "TAD" publication as "Handbook on Engineering Psychology", edited by Hilborn, and published by TAD in Cambridge, MA in 1965. Mr. Campus further identified the source of his data (justifying the 60 lb limit) as the 4th edition of McCormick. Mr. MacGowan expressed surprise at McCormick as the source as he said: "I have gone through that and can find nothing which I believe to be pertinent. The only thing which I think is even remotely related is on page 179. These are data for a set of seated subjects based on data from a 1955 study. I will take another look and see if I have missed something. I will also keep looking for additional data."

Early in December, Mr. MacGowan called Mr. Hapgood. He reported: "I have gone through McCormick thoroughly and can find nothing other than page 179 on which I previously commented. I managed to get through to Prof. McCormick on the telephone. I explained to him what sort of data I was seeking, i.e., push up and away on a lever, push down on a lever, in both cases with the subject standing as an operator would do with the high-rail equipment. I believe he understood what I was seeking. He told me he was not aware of any such data.

I have searched but found nothing in ANSI or OSHA literature which relates to this situation. I have, however, found some other sources of anthropometric data. I do not yet have copies of these but will try to do so in the near future."

Mr. Hapgood replied that Mr. MacGowan should keep searching and keep him informed.

Early in January 1984, Mr. MacGowan reported again to Mr. Hapgood.

"I found a book by Damon and others in 1966 which uses the same 1955 data in McCormick, -- that's no help.

The third edition of McCormick has the same data (and no other remotely pertinent) that is in the 4th edition -- thus no help.

A 1972 military document, edited by Van Cott & Kinkade, has some data which would tend to support Mr. Campus' position, but again the physical arrangement of the reported testing really does not come close to simulating the high-rail situation.

Murrell says that a standing adult male pulling up on a horizontal lever about 30 inches above a floor, can exert a maximum force of 105 lbs with one hand. This comes closer than any of the others cited above.

Woodson shows some interesting data which seems more applicable than any of the others. I am sending a copy of the more pertinent data.* This certainly can be used to differ with Mr. Campus and his 60 pound limit.

I have also seen references to a NASA document called 'Anthropometric Source Book'. This may have some useful data. I shall try to locate a copy."

Late in January 1984, Mr. MacGowan called Mr. Hapgood again.

MacGowan: "I managed to locate a copy of the NASA document and search through it. The only data which was remotely related to our situation was from a set of tests which were quite similar to those quoted by McCormick, but more extensive. The data were given in kiloponds, a unit which is not common in the U.S. I managed to find the conversion factor for kiloponds and it turns out that these data are no more useful than McCormick's, i.e., they will not be useful in refuting Mr. Campus. So at this stage, the only data which I see as being useful for refutation purposes are those from Woodson, and perhaps Murrell. It is obvious that one could hope for better and more consistent data."

Hapgood: "So be it. Can we arrange a time to get together and let you see and operate the high-rail equipment?

MacGowan: "Sure. When do you have in mind?"

Hapgood: "How about the first of February about 9:00 a.m. at the Snowshoe yard on 25th St?"

MacGowan: "That sounds fine. I'll see you then."

Mr. MacGowan and Mr. Hapgood met as agreed. They went out with a driver to operate the high-rail equipment. The driver placed the vehicle in the proper position on the tracks. Then Mr. MacGowan tried the equipment (Mr. Hapgood declined to do so). Mr. MacGowan found the operation to be very simple and that after three practice runs, he was able to lower the guide wheels into position and retract them with no problem in the sequence of operation. It was his opinion that pushing on the lever to place the guide wheel on the track required somewhat more force than was required to retract the wheel. He made some crude measurements of the required force with a spring scale. As a result of this, he was willing to accept Mr. Campus' measurement of 90 pounds as reasonable. It waa also his opinion that while the forces required to operate the high-rail equipment were significant, it was not difficult for him to operate the equipment. (It might be noted that Mr. MacGowan never was an athlete, was not a jogger, was somewhat overweight, and was in his early 60's.)

After the operation was finished, all returned in the vehicle to the Snowshoe yards. Mr. MacGowan and Mr. Hapgood then spent some time discussing the various facets of the case, partly to assess the situation, and partly by way of preliminary preparation for Mr. MacGowan's deposition. Mr. Hapgood also noted a trial date of May 1, 1984.

*Exhibit C2

About the middle of April, Mr. Hapgood called Mr. MacGowan to tell him that his deposition was scheduled for April 27, 1984. They agreed to meet about an hour before the time for the deposition in order to review the situation and agree on how responses were to be made to questions.

LIST OF EXHIBITS

Exhibit C1

List of References in Sequence Cited

McCormick, E.J., "Human Factors in Engineering and Design," 4th Edition, McGraw-Hill Book Co., 1976

Hammer, W., "Handbook of System and Product Safety," Prentice-Hall, 1972

Hammer, W., "Occupational Safety Management and Engineering," Prentice-Hall, 1976

Hammer, W., "Product Safety Management and Engineering," Prentice-Hall, 1980

Damon, A., H.W. Stoudt, R.A. McFarland, "The Human Body in Equipment Design," Harvard University Press, 1966.

McCormick, E.J., "Human Factors Engineering," 3rd Edition, McGraw-Hill Book Co., 1970

Van Cott, H.P., and R.G. Kinkade, "Human Engineering Guide to Equipment Design," American Institute for Research, Washington, D.C., 1972

Murrell, K.F.H., "Human Performance in Industry," Holt, Rinehart, Winston, 1965

Woodson, W.E., "Human Factors Design Handbook," McGraw-Hill Book Co., 1981

----- "Anthropometric Source Book, Volume I: Anthropometry for Designers," NASA Reference Publication 1024, Edited by Staff of Anthropology Research Project, Webb Associates, Yellow Springs, Ohio, 1978 (National Astronautics and Space Administration, Scientific and Technical Information Office)

Exhibit C2 Data Taken from Woodson, (See Exhibit C1)

774 **HUMAN STRENGTH**
General Strength-Limit Expectations

GENERAL HUMAN STRENGTH-LIMIT EXPECTATIONS

Since people do not always use the best method for applying force, one should not plan on using maximum capability values for design. The nominal values shown in the accompanying illustrations are suggested for various common force-application activities.

Although people can lift more than the values shown in the accompanying illustration, one should not expect more from an operator (i.e., these are 5th-percentile values when the individual tries to lift using only back-muscle power).

The lower illustrations represent maximum force expectations for adult males. For females, one should cut the values approximately in half.

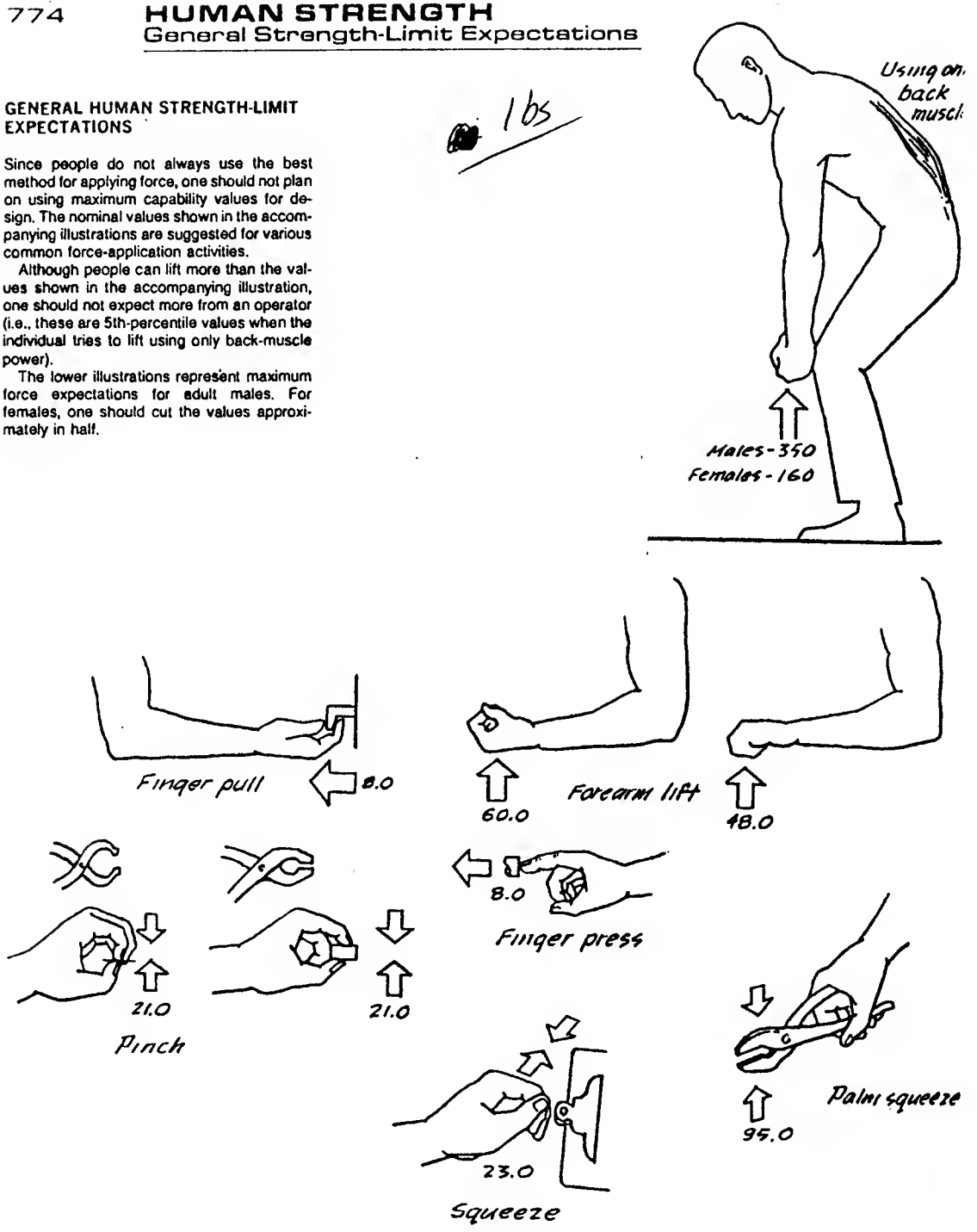


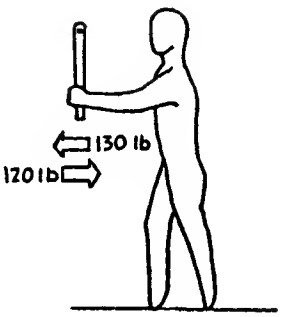
Exhibit C2 (continued)

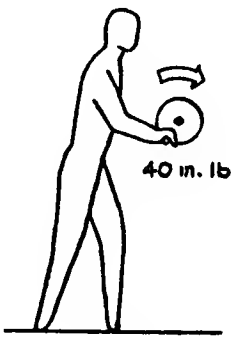
776 **HUMAN STRENGTH**
Force Limits—Standing Position

FORCE LIMITS FROM A STANDING POSITION

General upper force-limit approximations for typical control operations are illustrated in the accompanying sketches. These assume that the point of force application has been optimized (i.e., between waist and shoulder height above the floor).

1. Force Limits for Lever-Type Controls
Although slightly higher values could be expected if both hands were used, the values are representative of the upper design limit, assuming that the operator has no special aids to help in retaining his or her primary body position (i.e., something to push against).



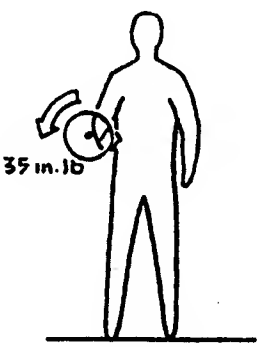


2. Force Limits for Hand Cranking
The best hand-cranking positions are illustrated in the accompanying sketches. The value shown assumes a wheel diameter between about 4.5 and 8.0 in (11.4 and 20 cm). Cranking efficiency and capability to apply maximum forces diminish rapidly when wheel diameters are either smaller or greater than noted.

Note that force limits should be lower when the cranking plane is parallel to the operator's own frontal plane.

If hand cranks are located overhead, the upper force-limit values should be reduced by 40 to 50 percent.

Note: Physical activity incurs some physical debt as a consequence of the physiological work load and/or the work environment. If the work rate is low enough, a muscle group can function almost indefinitely. However, at high rates muscles soon fatigue and, in some cases, may cease to function effectively altogether. The values illustrated in the accompanying sketches apply to reasonably slow and infrequent manipulation of the particular control.



MY ACHING BACK PART D

On the 25th of April, Mr. MacGowan received a phone call from Mr. Hapgood to tell him his deposition would not be needed -- that the case was settled.

It might be of interest that the settlement was for $80,000. This sounds like a substantial sum, but it is less than Mr. Hope's lost wages between the time of injury and time of settlement.

MY ACHING BACK INSTRUCTOR'S NOTE

The purpose of an Instructor's Note is to offer some suggestions which may be helpful to anyone using a case for instructional purposes. It is NOT intended, in any sense, to tell the instructor how to use the case. Some references are given which may be helpful in considering a variety of ways of using cases.

At the end of Part A, one obvious possibility is that the student might be asked to assume the role of Mr. MacGowan. In this role, he/she should examine the data supplied and then determine what he/she will tell Mr. Hapgood.

A number of questions are suggested which may provide some focus for students.

1. In products liability litigation, the normal situation is that the employee does not (in essentially all jurisdictions can not) sue the employer. How is it that Mr. Hope is suing his employer, Snowshoe Railroad? [The prohibition on suing an employer dates back to shortly after the beginning of the 20th century when Workmen's Compensation developed. In return for this type of provision for compensation for "on-the-job" injury, workers agreed to forego the right to sue the employer -- a right which was little used since filing suit nearly always resulted in immediate dismissal of the employee. In this case, Mr. Hope can enter such suit since many railroad employee/employer relationships are governed by specific "railroad" laws, relationships which often differ drastically from those in most other industries.]

2. What characteristics (physical,mental, emotional, etc.) are necessary in an individual in order to be able to perform tasks in keeping with Exhibit A2? How will the knowledge of these job characteristics affect the design parameters of the high-rail device?

3. Do you find the instructions given in Exhibit A3 to be clear? Do you think you could operate this equipment based on the instructions given? If not, what suggestions do you have to improve clarity? [This critique can obviously include writing style.]

4. Does Mr. Hope's description of his alleged injury sound credible? If not, what is needed to provide credibility?

5. Is the procedure to which Mr. Hope testifies consistent with that given in the Fairhill instructions? If not, what are the inconsistencies or differences? Could these differences or inconsistencies have resulted in the injury of Mr. Hope? Do you think the sequence of placing the wheels on the tracks would affect the force required to lower the handle? [One point in particular is the sequence of the four wheels being placed on the tracks and being removed.]

6. After having digested the information given in Part A, what is your reaction to the four points alleged by Mr. Hope?

7. How can one be sure that Mr. Hope's surgery was a result of the alleged work injury rather than from some activity which was not job-related? What is your reaction to the fact that three weeks elapsed between the time of the alleged injury and reporting it to Snowshoe?

8. In your role as Mr. MacGowan, do you have enough information to form a good opinion [good defined as a probability of at least 51% of being correct]? If not, what information do you need? Where would you expect to get this desired information?

9. Based on the information available in Part A (all that was available to Mr.MacGowan), what sort of testimony would you be able to give as an expert witness?

10. What is your reaction to the lead time aspect, i.e., Mr. Hapgood's telephone call with relation to trial date? Do you think this kind of "last minute" effort is common? [Unfortunately, it is in a significant fraction of products liability cases.]

Part B

Obvious use of Part B is to have the student continue the role of Mr. MacGowan, as in Part A.

1. Having read Mr. MacGowan's initial comments to Mr. Hapgood, how much do you agree with Mr. MacGowan? [There is nothing implied here that Mr. MacGowan knows all the answers or has not overlooked something.] What pertinent aspects do you see on which he made no comment?

2. How do you feel with regard to Mr. MacGowan's comment on the "backward" operation of the high-rail device? Is he correct? If you disagree with him, give your reasons.

3. If you had been retained as an expert witness by Mr. Hapgood, would you also want to see and operate the equipment as Mr. MacGowan said? Why or why not?

4. What is your reaction to the postponement of trial? Do you think this is a common occurrence in products liability suits? [It is a rare case that goes to trial on the first trial date set.]

5. What is your reaction to Mr. Knight's testimony relative to human factors (e.g., questions 5 and 6)? What factors are unnecessary? What factors are missing?

6. If you were Mr. Knight, how would your answer differ on questions 13 through 23?

7. What is your reaction to Mr. Knight's answers to questions 24 through 29?

8. What are your comments on the validity of using strain gage techniques to measure the force normal to the lever?

9. What is your reaction to the basis on which Mr. Knight chose the 100 lb limit on force applied to the lever? Is this good human factors? Is this good engineering practice?

10. If tests were performed inside a building at normal room temperature, what effect on the force required to operate the high-rail device would you expect to find in the field on a cold winter day?

11. Do you agree that the spring rate of the vehicle suspension system would affect the force required to operate the high-rail equipment? Why or why not? What about the effect of shock absorbers?

12. Mr. Roper obviously interrupted many times in the course of Mr. Knight's deposition, e.g., as compared with the deposition of Mr. Hope (Exhibit A4). Do you believe this is a common occurrence? If so, why? If you think Mr. Roper interrupted (or objected) more than is usual, why did he do so? [The matter of objections by an attorney is normally based on a number of factors. One factor is related to the personality of the attorney and how he has developed his own style of operation. In this situation, Mr. Roper was trying to work in such a way that Fairhill would not become a party to the suit, or if it should, that the impact (or exposure) would be minimized. Thus, he was involved in what one might possibly view as "preventive maintenance".]

13. What is your reaction to the rates quoted by Mr. Campus in questions 3 and 4? Do you think these are out of line with fees charged by other expert witnesses? [The fees quoted are in line with those charged by a substantial number of experts, although perhaps on the high side of average.]

14. In view of your review of Exhibit A3, what is your reaction to Mr. Campus' answer to question 29 (Exhibit B2)?

15. What do you think of the merits of using a spring scale to measure the force required to move the lever? Can you suggest a better way which will be easier and at least as accurate (preferably more accurate)?

16. Is there any possible confusion between "foot-pounds" as used in question 40 and as used in question 41? How do you react to Mr. Campus' answer to question 41? (Exhibit B2) Give some details.

17. How do you react to Mr. Campus' answer to question 42? (Exhibit B2) For example, one aspect refers back to his answer to question 41 - does this clarify? How would you change or clarify his answer? A second aspect is the matter of one/two hand operation -- are the pins applied or removed while the lever is being moved? In other words, how would you have testified if you had been Mr. Campus?

18. Mr. Campus testified that he knew of no directly applicable Federal or state standards. Do you believe he is

correct? What about the Occupational Safety and Health Administration (OSHA) requirements? What about the National Standards Institute (ANSI) standards? [There appear to be no OSHA or ANSI standards which apply or could be extrapolated to give guidance.]

19. What is your reaction to the 60 pounds limit cited by Mr. Campus in question 55? (Exhibit B2) Do you believe this is reasonable? Can you find data to support or refute this number?

20. What is your reaction to the answers to questions 57 through 61? How would your answer differ? Is Mr. Campus making statements which are consistent with good human factors engineering? If not, why not? (Exhibit B2)

21. How would you respond to questions 64 and 65? (Exhibit B2)

22. How would you respond to question 66? Can you improve on this design? Can you devise a different design which is different and "better"? (Exhibit B2)

23. Assuming you have a different opinion than Mr. Campus, how would you respond to questions 68 and 69? (Exhibit B2)

24. What are you going to tell Mr. Hapgood now that you have the benefit of the information in Parts A and B? Or, how would you now answer questions A8 and A9, having the additional information in Part B?

Part C

Hopefully, the student has been able to find some anthropometric data that are applicable (not an easy task!).

It might be noted that Part C is segmented. This allows an opportunity to treat Part C as a whole or to take it in segments.

1. How does your report to Mr. Hapgood compare with that of Mr. MacGowan?

2. Do you agree with Mr. MacGowan that the key issue at this point is the question of how much force a worker might be expected to exert? If not, what do you believe to be the key issue?

3. Would you have taken the initiative to "track down" Prof. McCormick as Mr. MacGowan did? If not, why not? What do you see as the pros and cons of such a step?

4. Do you think that the literature search (largely fruitless) by Mr. MacGowan is typical? Or is this an unusual case? If you did some literature search, what success did you have?

5. Do you see the data cited from Murrell and Woodson as helpful? If not, why not? If not, what data will you use to refute Mr. Campus?

6. Mr. MacGowan tells Mr. Hapgood that the data in the NASA document cited is given in kiloponds. This is NOT a typographical error, i.e., "kilopounds" is not intended. Can you determine the conversion factor for kiloponds? [The unit of kiloponds appears to be a relatively common unit in Europe. The editor of NASA Reference Publication 1024 says that one kilopond is one kilogram force. Conversion to pounds-force is thus easy. It should also be noted that these units are not standard in SI.]

7. What, in your opinion, is the significance of Mr. MacGowan and Mr. Hapgood meeting to agree on how responses were to be made to questions during depositions? Does this imply that Mr. MacGowan will not be truthful during his deposition? What does it imply? [There is no implication of untruthfulness. The key point is the question of how Mr. Hapgood wants to "play" the adversary "game." Does he want Mr. MacGowan to "lay it on them" or does he want Mr. MacGowan to be reticient and make Mr. Edwards "dig" for answers? Another aspect is how answers are given. For example, consider a 12 oz. container with 6 oz. of contents. Is this half full or half empty? Either answer is correct, but the implications of the two answers are somewhat different.]

8. In your role of Mr. MacGowan, what testimony will you be willing to give when deposed? Perhaps reference to Exhibit A1, with the four points of allegation, will be helpful. Can you refute Mr. Campus' testimony on the limiting force? If so, how (or with what data)?

9. How much force should be required to operate this high-rail device?

10. Can you design a better device? If so, how will it function? How much foroe will be required for operation? How much will it cost? How will environmental conditions affect the

function? Will it function properly and in a safe manner under all foreseeable circumstances.

11. If you were on a jury hearing the trial of this case, what do you think you would decide -- a verdict for the plaintiff or "no cause", i.e., a verdict for the defendent? If a verdict for the plaintiff, how much would you award in damages?

[Since termination of the case, an additional reference has been noted: "The Design of Manual Handling Tasks", by S.H. Snook, ERGONOMICS, 1978, Vol. 21, No. 12, 963-985. Some data in this paper appear potentially relevant.] [One reviewer commented that attention should be drawn to the obvious flaw in Knight's logic. (Knight was the design engineer). At the initiation of the design process, Knight was presented with the challenge of generating a machine or device what would allow cars and pickup trucks to be driven on railroad tracks. This was the crucial step of the design process in which design parameters were specified. Knight's selection of 100 lb-force to raise or lower the high-rail device was not sound engineering judgment. Lifting and carrying guidelines, human factors considerations, and the amount of force an average person can reasonably exert should all have been considered in determining this design parameter rather than selecting an arbitrary value.]

As written, with the deposition material, this case is perhaps somewhat lengthy. Some instructors may thus see it as too much reading. As an alternative, condensations of Exhibits A4, B1 and B2 follow. These may be distributed to students in lieu of the exhibits, if desired.

Deposition

A deposition is the testimony of a witness (party or nonparty) taken before an officer of the court but not in court. "Testimony" means oral statements of the defendant made under oath and subject to penalties of examination. A complete record is made of the proceedings by a certified court reporter. Such oral depositions are a major part of the discovery process.

At the start of a deposition, the court reporter administers the oath to the witness. Each deposition is unique, since it must be tailored to the subject matter and the specific witness. Questions generally fall into three categories: (1) identity and background information about the witness; (2) facts and information he or she has about the issues, and (3) facts and information he or she has about the damages. Each lawyer present has the privilege of asking questions of the witness, even though only one lawyer served notice for taking the deposition.

Most depositions are taken for discovery purposes, that is, to determine what the deponent knows about the occurrence in question. Once a deposition is taken, however, it may be used for various other purposes. Should a witness die, or be unavailable to testify at trial, any party may elect to use all (or selected portions) of the deposition in lieu of a personal appearance of the witness. If any statement in the deposition is contrary to sworn testimony at trial, the inconsistency can be shown for the purposes of impeachment. Impeachment simply affects the weight or credibility of the testimony. It does not disqualify the witness or necessarily subject him or her to penalties. If a witness is guilty of perjury, however, he or she could be found in contempt of court and criminal charges could be filed against the witness.

Condensation of Exhibit A4

Mr. Hope was in the process of releasing the left front (from the vehicle driver's position) guide wheel when he felt a "crunching" or "grinding" in his lower back. He completed getting the vehicle off the track and went about his normal duties. He described the high-rail equipment in terms consistent with Exhibit A3, with the exception of the sequence of wheels (Exhibit A3 says rear wheels first, Mr. Hope was specific on front wheels first). He used this specific vehicle on a daily basis.

Safety rule book was reviewed at least once a year. Vehicle had a Chevrolet operator's manual but none for the high-rail equipment. He described his actions in terms consistent with Exhibit A3. He could not give a number for the pounds of force which he exerted. He believed it took about the same force to lock the guide wheels for use as to release them when removing the vehicle from the rails.

He was injured on 2 February 1981 but did not report it to Snowshoe until 23 February 1981. He worked every day after his injury with no apparent problems with his back. His work was not affected except that he was careful when he lifted

something. He could not recall that he used the high-rail equipment after being injured. He was in the hospital for about a week after microsurgery for removal of a disk.

Condensation of Exhibit B1

Mr. Knight briefly described his understanding of the circumstances of the situation at the time of the alleged injury. As the designer, he attempted to take human factors into account so that a minimum of physical effort would be required to apply the high-rail equipment to the track or to remove it from the track. Tests were run to determine the force (or physical effort) required. This was done by using strain gages on the lever bar. He gave the important variables: gross weight; dimensions apecified in the drawings and service instructions; vehicle must be properly lubricated; tire pressure must be maintained at recommended levels; loading on pilot (guide) wheels must be adjusted to be less than atated maximum values.

Design was on the basis of a maximum of 100 pounds force on the lever bar to operate the high-rail equipment. This value was arbitrary and selected by him on the basis that he is physically small and if he could exert the 100 lbs., any railroad worker should be able to also do so. There is a difference in the length of arc in locking or unlocking but the force exerted is about the same in both cases. No recommendation was made (or specified) as to the position of the operator when raising or lowering the vehicle on the track. He has used the equipment himself. Owner of vehicles using high rail equipment should maintain vehicles in compliance with Fairhill recommendations. Operators should be instructed to either do maintenance, or see that maintenance is done in compliance with Fairhill recommendations. This is the responsibility of the operator's supervisor. It was a design objective that this equipment could be successfully used by one individual. Objective was achieved in the design.

Condensation of Exhibit B2

This was the first time Mr. Campus had been involved in a case relating to railroads and high-rail equipment. He had been supplied drawings, manufacturer's literature, and depositions. He had been told the elements of the situation when Mr. Hope was injured. He had reviewed all this material. He had been told that the weather was wet, cold, icy, and snowy. He had been told that Mr. Hope had not been given any specific instructions on using the high-rail equipment.

He had observed the equipment and conducted some tests in June 1982 (he thought). He noted that the equipment had been repaired. He observed Mr. Edwards operate the equipment. It was Mr. Campus' opinion that it is not a straightforward process, that it was hard to predict the point where effort is required thus throwing the operator off-balance in both a physical and psychological sense. He measured the force required for operation at a maximum value of 90 lb. Measurement was made with a spring scale. He determined that 76 ft-lb were required for the upward direction and 70 ft-lb for the downward direction. He did not think this difference was very significant. He testified that the bar must be pushed with one hand while the pin is being removed with the other. Thus, there is one hand operation for part of the time with an opportunity for two hand operation the rest of the time. The body must be shifted a number of times in the process of locking or releasing a guide wheel. Both he and Mr. Edwards operated the equipment.

He knows of no Federal or atate standards which apply. Some OSHA data are pertinent in the sense of giving guidance to proper ways of lifting, carrying, and pushing. The body should be kept as balanced and symmetrical as possible when doing work.

In his opinion the recommended maximum for lifting and pushing is 60 lb. This number was obtained from a "couple of human factors manuals" which he could not specifically identify at the time. He believed there was a better way to design the equipment but since he was not a mechanical engineer, he made no suggestions as to how this might be done.

It was his opinion that the difficulties in operating the equipment had a great deal to do with causation of the accident. These difficulties included the amount of work necessary (in ft-lb), the force required, body position, changing from one-hand to two-hand operation, crouching under bad weather conditions, cold and snowy weather, and lack of lubrication.

References which may be useful in suggesting ways to use cases.

Kardos, G. & C.O. Smith, "Engineering Cases as Tools for Teaching Design", Mechanical Engineering, March 1983, pp 68-71

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Fuchs, H.O., "Outside Reality - Inside the Classroom", Engineering Education, March 1970, pp 745-747

Vesper, K.H., "On the Use of Case Studies for Teaching Engineering," Jrnl. of Engineering Education, October 1964, pp 56,57